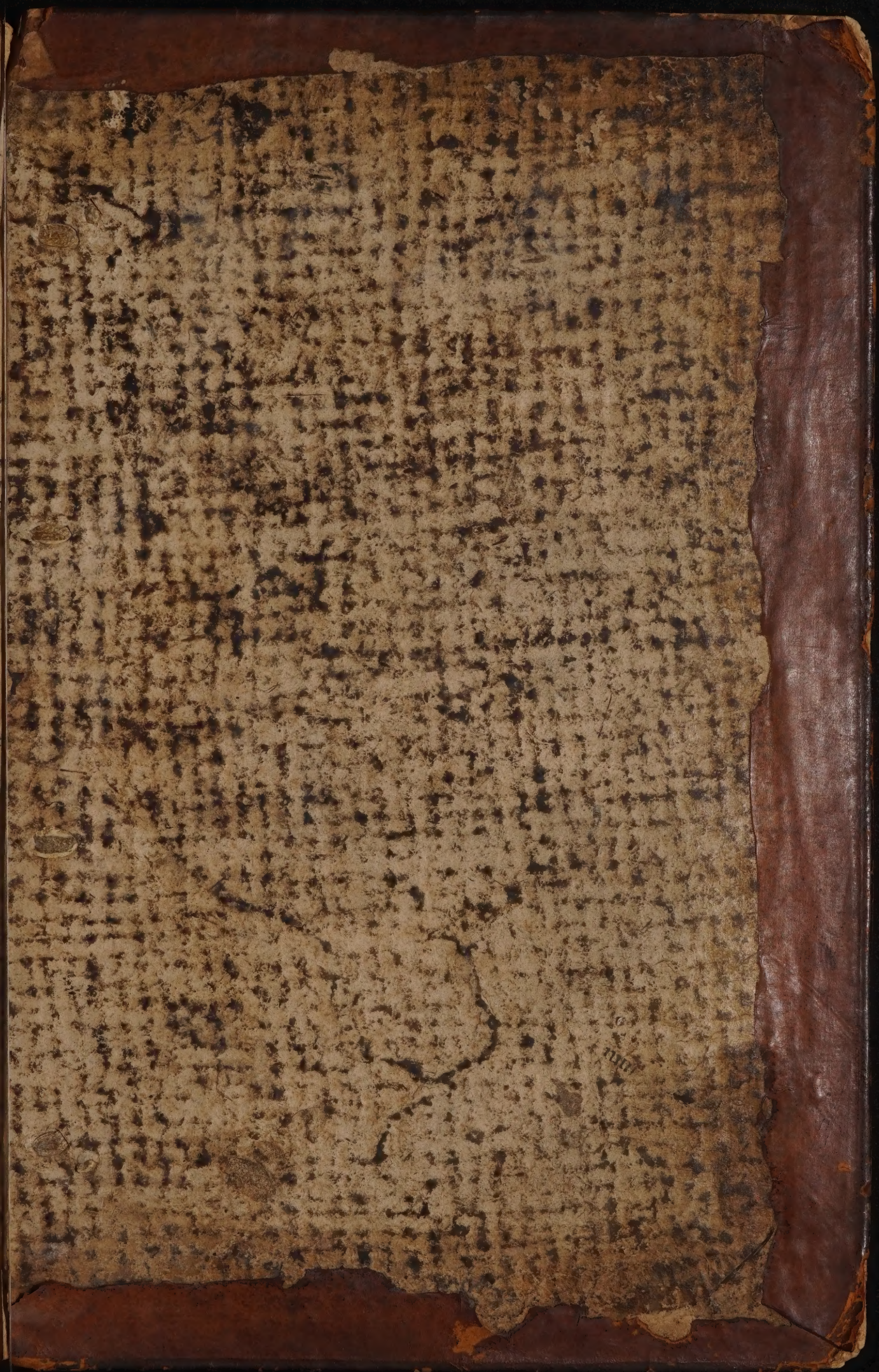

Ὤμιλλα. ludi genus quoddam, in gyrum ieu rotam agitata nux, si immanserit, victoria paratur. Suid.

Ὠμοβόϊνος. ου. ὁ.

Ὠμοβόϊος. α. ὁ. ex pelle bubula cruda factus. Sic uocant eos, qui in prima iam senectute sunt.

Ὠμοβόρος. ὁ. ὠμοφάγος, ὠμηστής.

Ὠμογέρων. qui immature canescit, uel cui iam senescenti nondũ canescunt capilli, uictus & ualidus senex, crudus adhuc, & quem nondum decoxit senectus. Vnde Vergil. Sed cruda deo, uiridisq; senectus.

Ὠμοδιάκτος. dilaniatus.

Ὠμοθάλεκος. α. ὁ. crudus, ὠμός.

Ὠμοθετέω. μ. ήσω. π. κα. humeris impono, cruda pono. Actiu. accus.

Ὠμοιαῖος. α. ὁ. humerarius.

Ὤμοι pro οἴμοι. heu indignantis aduerbium, & dolentis.

Ὅμοιος Aeolice pro ὅμοιος. similis.

Ὠμοκρατής. ἐος. ὁ, ἡ. fortis humeros.

Ὠμοκυδιάω. ob latitudinem humerorum, & bonam corporis habitudinem superbire.

Ὠμόλινον. α. τὸ. sudarium tonsorium, quod humeris circumponitur.

Ὠμοπλάται. ossa duo quæ utrinq; à ceruice ad scapulas tendunt, à Latinis operta scoptula dicta. Cels. cap. 1.

Ὠμοργής. ὁ.

Ὠμόργος. ὁ. ὁ. durus, acerbus, χαλεπός.

Ὤμορεν. suspirabat, lugebat.

Ὦμος. α. ὁ. humerus, μετάφρενον.

Ὠμός. ὀν. ὁ. immaturus, crudus, acerbus, crudelis.

Ὠμόσιτος. α. ὁ. cruda comedens.

Ὠμοστάσιχος. salsamentum.

Ὠμότατα. crudelissimè.

Ὠμότης. τος. ἡ. crudelitas, ἀπλωότης.

Ὠμοτοκέω. fœtum immaturum parere, abortum facere.

Ὠμοφαγία. ας. ἡ. uisceratio.

Ὠμοφάγος. α. ὁ. ὠμόσιτος, crudis uescens.

Ὠμόφορος. idem.

Ὠμόφρων. ονος. ὁ. habens crudam mentem.

Ὠμύς. genus testudinis quam lutariam uocant.

Ὤμωξεν. plorauit, ab οἰμώζω.

Ὠμῶς. crudeliter.

Ω Ν.

Ὧν Ionicè & Doricè pro οὖν. igitur. Sæpe apud Herodot. non solum πρὸ ἑλκέ, sed etiam inter præpositionem & uerbum compositum interponitur, ut lib. 2. οἱ δὲ φέροντες ἐς τὴν ἀγορὴν ὧν ἐπ' ὧν ἔθεντο, αὐτὶ τοῦ ἀπέθεντο. Bud. Com.

Ὧν οὗτοι κλέπτουσιν ὀργίζεσθαι, apud Lys. pro ὑπὲρ ὧν. Sic ὧν ἔπαθεν ὀργὴν ἔχει, apud eundem. Bud. Com.

Ὧναξ, pro ὦ ἄναξ. ὁ rex.

Ὠνέομαι. μ. ήσομαι. π. ἐώνημαι. emo. Deponens. uel genit. qui partem rei significat.

Ὧνερ pro ὦ ἄνερ.

Ὠνεομάω. μ. άσω. emo.

Ὤνεον. mouebant & circumagebant, Thucy

Ὠνέω. uendo, fruor.

Ὠνή. ῆς. ἡ. emptio.

Ὤνηντο. iuuerunt.

Ὤνησις. actio, emptio, salus, utilitas, indign

Ὠνητός. οῦ. ὁ. uenalis.

Ὤνθρωπος pro ὦ ἄνθρωπος, Atticè.

Ὤνια. loca opportuna.

Ὤνιος. uenalis, πρόσιμος, δῶνος.

Ὦνος. α. ὁ. precium, emptio.

Ω Ο.

Ὠοειδῆ τὰ. ouata.

Ὠοειδής. ἐος. ὁ, ἡ. ouiformis.

Ὠόν. οῦ. τὸ. ouum. οἷον τὸ οἷον. μόνον γὰρ τ
ται. Etym.

Ὦον. fimbria.

Ὠόπ, & ὠοπόπ. acclamatio nautica, ἐλατικ
φθεγμα τῶν πλοίου, καὶ κέλευσμα τῶν
όντων καταπαῦον τὴν κωπηλασίαν.
Comment.

Ὠοτόκα. τὰ. ouipara.

Ὠοτόκια. ας. ἡ. partus, generatio oui.

Ὦ σύ. heus tu.

Ὠοφυλακεῖ. custodit.

Ω Π.

Ὠπάζομαι. uideo, speculor.

Ὤπασε. dedit, donauit.

Ὧπερ. tanquam. Etym.

Ὦπες. oculi.

Ὠπία. gens, quæ iuxta Indum fluuium h

Ὠπόλος. ὁ ἀπόλος.

Ὤποποι. heu, papæ, indignantis, dolent uerbium.

Ω Ρ.

Ὧρα. ας. ἡ. cura, sine aspiratione.

Ὥρα. ας. ἡ. pulchritudo, decor, forma, uen
cura, quarta pars anni. Etym. ὧραι item
tur quatuor partes anni, ut uer, æstas,
nus, hyems. Et sine adiuncto plæru
uere ponitur. Vnde & ὡραῖος form
similitudinem ueris. Galen. ait sic a
tempus id, quo exoritur canicula, quoc
quit) ferè dierum quadraginta. Sunt
portarum cœli custodes apud Homeru
famulæ Solis deæ pulchritudinis.

Ὡραῖα γάμος. puella matura uiro.

Ὡραΐζομαι. μ. ίσομαι. π. ισμαι. delicior, co
core, conspicuus sum, decorem ostent
De pauone dicitur, cum semetipsum a
caud[illegible]nis gemmantibus pertegit.

Ὡραΐζω. orno, καλλωπίζω.

Ὡρ

...ωτερον.canorius.
...δίν.ῖνος.ἡ. dolor partus.
...δίνω.μ.ινῶ. doleo in partu, parturio. Accipitur simpliciter pro doleo. Interdum pro tumeo.
...δὶς.ῖνος. ἡ. uexatio partus, parturigo.
...δὸς.ἀοιδὸς, cantor.
...δύζομαι. irascor, doleo, ἄχθομαι.

Ω Ε.

...ἐ. aduerbium dolentis.

Ω Ζ.

...ζειν. clamare.

Ω Η.

...ἠ. est aduerb. uocantis. Etym.
...ηθν. putabat. à uerbo οἴομαι.

Ω Θ.

...θομαι.
...θέω.μ.ήσω.π.ηκα. expello, impello, impressionem do (ut dixit Liuius) pungo, obijcio. ὠθοῦμαι tamen interdum passiuè accipitur.
...ίζεσθαι. dicuntur qui conferta turba conflictari..., uel in prætorijs, & ædibus magistratuum summam reip. tenentium, Synes. πυλαιμαχεῖ, & Luciano. Et idem, βαβαὶ ὡς πλήρης μὲν ἡ αὐλὴ ...ς ὠθιζομένων, &c. audito præconio præmiū pronunciātę. quoniā uero in huiuscemodi pro...fusione, & nixu cōflictante solēt homines interdum altercari & rixari, ideo factū est, ut pro discrepare & uerbis contendere ponatur, & in unam sententiam conuenire non posse, Hero...o. in Thal. Ponitur etiam pro irruere & irrumpere in locum periculosum, Gregor. 2. cont. ... & apud eundem, πρὸς τὸ ξίφος ὠθίζεσθαι. id ..., in gladium uel uenabulum sese obtrudere, aduersum mucronem obniti.
...ω. uexo, concutio, uiolenter tracto. Bud. Cō. ... ὠθίζεσθαι dicitur.
...μός.ȣ̃.ὁ. impulsio, & turbulēta altercatio in... se discrepantium, Luciano Gregor. pro cō...tatione plebis miscellaneæ posuit.
...μαι.
...μ.ώσω.π. ὦκα. idem quod ὠθέομαι, & ὠ... Vnde ὦσε κατὰ τῶν σπλάγχνων, pugio... confodit.

Ω Ι.

...fimbria, extremitas, pellis ouina, molestia.
...ντο. patuerunt. ab οἰγνύομαι.
...aperuit. ab οἴγω, οἴξω, aperio.

Ω Κ.

...pro ὠκέα, siue ὠκέα syncopa. celeriter.
...celeriter.
...νός. oceanus, mare ambiens orbem terrarum.
...δες. ocimastrum herba.
...uelocissimè.
...ȣ.ὁ. uelocissimus.
...κτείρω. misertus est, ab οἰκτείρω.
Ὠκύαλος.ȣ.ὁ. uelox in mari. epitheton nauis.
Ὠκύμολος.ȣ.ὁ. statim proficiscens.
Ὤκιμον.ȣ.τὸ. ocymum herba, à celeritate nascendi sic appellata.
Ὠκύμορος. ου.ὁ. cito perituꝛus, cito afferens perniciem.
Ὠκύνω. accelero, ὀξύνω.
Ὠκυπέτης.ȣ.ὁ. celeriter uolans.
Ὠκύπορος. fluuij aut nauis epitheton, quòd celeriter uel rapidè feratur.
Ὠκύπους.οδος.ὁ,ἡ. celer pedes.
Ὠκύπτερα.τά. pennæ.
Ὠκύπτερος.ȣ.ὁ. celeriter uolans, pernix.
Ὠκύρροος. celeriter fluens.
Ὠκύς.έος.ὁ. citus, ὀξὺς, ταχύς.
Ὠκύτης. celeritas.
Ὠκυτόκιον. medicamentū partum accelerans.

Ω Λ.

Ὦλαξ, pro αὖλαξ. sulcus.
Ὠλέκρανα, id est ὁ ἀγκών, apud Suidā: & ὠλέκρανον, ὁ ἀγών apud Hesych. Sunt qui ὠλέκρανον lacertum interpretantur.
Ὠλιγγ.ης.ἡ.
Ὠλένος.ȣ.ὁ. ulna, manus, palma. ἀπὸ τῶν δὲ αὐτῶν ὀλῶσθαι τὰς πράξεις, τοῖς τε πληρῶσαι.
Ὠλεσίκαρποι. arbores infructuosæ. Epitheton salicum, uel quòd fructus citò amittāt, uel quòd steriles faciat fructus epotus.
Ὠλίγγη.ἡ. minima. ponunt Attici & pro nictatione. significat & flatum & exilem spiritū. & umbram. Etym.
Ὠλίγγιος.ὁ. paucus. Etym.
Ὦλλος, pro ὁ ἄλλος. alius.
Ὦλξ. sulcus. pro eo magis in usu est ἄλοξ.
Ὠλοκρατον.ȣ. gibber, pars corporis.
Ὠλύγιος. malus, obscurus, lōgus, acutus, magnus.
Ὠλῶιστε pro ὦ λῷστε, id est ὦ βέλτιστε, o optime, Suidas.

Ω Μ.

Ὠμαδίς. in humeris.
Ὠμαλθές. τὸ ulcus ante tempus in cicatrice inductum.
Ὠμαχθής.έος.ὁ,ἡ. onus humeris imponens.
Ὤμβρος.ȣ.ὁ. malus, miser.
Ὠμήλυσις. hordeacea polenta, siue farina.
Ὤμην. putabam. ab οἴομαι.
Ὠμήρησε. contingit, concurrit, obuiauit.
Ὠμησὶ. crudeliter.
Ὠμηστής.ȣ̃.ὁ. cruda comedens, crudis uescens. & de rationalibus quàm irrationalibus dicitur. Bud. Com.
Ὠμηρος.ȣ.ὁ,ἡ. crudelis.
Ὠμίας. qui repandis est humeris, εὐρύστερνος.
Ὠμιλος.ὁ. pauper.
Ὠμίζω.μ,ίσω.π.ικα. excludo.

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AND

FOUR MANUALS,

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10

London, Printed by *John Streater* living in *Clerken-well-Close* 1668.

C: U-U

The Introduction.

ANthropologia or the Doctrine of Mans Nature, is, though commonly, yet rightly divided into two Parts: *Anatomia* which treats of the Body and its Parts; and *Pſychologia*, which treats of the Soul.

Anatomia therefore [more rightly called Anatomy, that is Section, which St. *Ignatius* reckons as a kind of Martyrdom, *Cælius* terms *Apertio* an opening, and *Tertulianus Proſectio* a cutting up, whence the term *Proſector*, a Cutter up] that I may come to that which is my buſineſs; in as much as it is a part of Natural Philoſophy [for Medicinal Anatomy how ever uſeful and of which *Galen* treats in his Anatomical Adminiſtration, we muſt leave to Phyſitians] hath for its Subject the Body of any Animal or Live-wight whatſoever, whether frequenting the Land or or Waters, flying in the Air, &c. and not only the Body of Man. But we are wont moſt of all to ſearch into the ſtructure of Mans Body. 1. Becauſe of the great Perfection thereof, which is the Rule of Imperfection. 2. Becauſe the ſundry ſorts of Animals are almoſt infinite, ſo that to diſſect and ſearch into all of them, the life of man in this Age of the World is not ſufficient. 3. Becauſe of the incredible profit which thereby redounds to every man, who deſires perfectly to know himſelf, and this Houſe of his earthy Tabernacle, both the better to preſerve Health and to cure Diſeaſes: Nor can any man be a Natural Philoſopher or deſerve ſo to be called, unleſs he have the Doctrine of Anatomy at his fingers end, above all other Parts of Natural Philoſophy. Yet is not the Diſſection of other Creatures therefore unprofitable, or to be neglected by an Anatomiſt, partly by reaſon of the Analogie and Correſpondence they hold with the Body of Man, partly to attain to the Knowledg of the Motions of Living Creatures, and partly, to conclude, for the Exerciſe of an Anatomiſt and Surgeon. *Democritus* ſought the Seat and Nature of Choler in Living Creatures. After him *Galen* diſſected Apes and other Living Creatures, as alſo *Severinus*, *Aldrovandus*, *Caſtellus*, *Bronzerus*, *Panarolus* and my ſelf have cut up divers Living Creatures. By the cutting up of Creatures alive *Aſellius* found out the *Venæ lacteæ* or milkie Veins, and *Harvey* and *Walæus* found the motion of the Blood.

The Subject of Anatomy.

Why Anatomy treats chiefly of the Body of Man.

The Diſſection of other Animals is uſeful to an Anatomiſt and why?

Moreover, becauſe in regard of the variety of its Actions, the Body of Man does not conſiſt of one part all alike, but of ſundry; therefore we muſt know that the whole Body is divided into Parts containing, Parts contained, and Parts moving, according to the ancient Doctrine of *Hippocrates*: that is to ſay, into ſolid Parts, Humors and Spirits. And in this large acceptation, all things are called Parts which make up and compleat the Body, even the Nails, Hairs, Fat and Marrow. But ſtrictly and properly that is called a Part, which partakes of the form, and life of the whole, and ſuch the Anatomiſts accounts only the *ſolid* Parts. And therefore *Fernelius* hath well defined a Part to be *A Body joyned to the whole, partaking of the common Life thereof, and fitted for the performance of ſome Functions or Uſe.* But *Galen* accounts that a Part, which is a Body in ſome ſort joyned to the whole, and hath in part its own proper Circumſcription. Briefly, they ſay, that a part is properly;

The diviſion of the whol Body of Man.

What a Part is?

1. That which lives, is nouriſhed, but does not nouriſh any other Part. And ſo they exclude the Spirits, Humors, &c. alſo the Fat, which ſomtimes nouriſhes the Parts, and the Marrow of the Bones, as being their Nouriſhment.

What is the proper acceptation of the word Part.

2. That which is ſolid.

3. Which hath a proper Circumſcription of its own. The contrary whereof is in fat, which is terminated by the figure of the Parts adjacent.

4. Which is continued with the whole, Mathematically and Phyſically, both in reſpect of the Matter and Form joyntly conſidered.

5. Which is fitted for ſome Function or Uſe. And ſo Warts and Swellings, with other things which grow upon the living Body præternaturally, are excluded.

And that we may underſtand what is ment by Function and Uſe, I ſhall briefly open the ſame. An Action or Function may be either private or publick. The private Action is that whereby the Parts provide for themſelves; the publick is that whereby they provide for the whole live Creature. A publick Action as it is oppoſed to uſe, is the Action of the principal Part of an Organ which performes the whole Action. For every Action in the Body of a live-wight, hath according to *Galen*, a peculiar Particle, by which it is performed. For Examples ſake; The Skin hath of it ſelf a private Action, ſuch as the Attraction and Retention of Nouriſhment, &c. it hath alſo a publick action for the behoof of the whole Animal, viz. the diſcerning of the tangible Qualities, ſuch as are perceived by the Senſe of Feeling. So the action of the Liver is blood-making, of the Stones, Seed-making; of the Dugs Milk-making.

What is ment by the Action of a Part.

But the Uſe, is that help which the leſs principal Parts afford the more principal, in the performance of their Actions, which according to *Galen* is in all Parts, yea even in thoſe which have no action at all. It ſprings chiefly from three Fountaines, and they are,

What by the Uſe.

1. The proper *Temper* of the Part, that is to ſay the Symmetry or even proportion of the firſt Qualities. For Examples ſake, The Skin is in reſpect of the firſt Qualities temperate; and if

you ask wherefore, I answer, that it may be able to discern and judg of all tangible Qualities.

2. *Such things as follows the Temper*, and they are the second Qualities: Hardness, Softness, Thickness, Thinness, Compactness, Rarity, &c.

3. *Necessary Adjuncts*, as Magnitude, Number, Passages or Cavities, Figure, Conformation, Connexion, Situation, Surface. But I, in these Institutions, for the conveniency of Learners, shall, with other Anatomists, seldom observe this accurate difference between Action and Use especially, that I may avoid the tedious repetition of sundry things.

Which Part of the Body is first generated.

But before I proceed to the Division and Differences of Parts, I shal briefly resolve this question, *Which Part of the Body is first generated.* We must therefore know, that according to *Hippocrates*, all the Parts are formed and differenced at one and the same time, as in a Circle, there is neither beginning nor end, but altogether are both beginning and end. But all the Parts are not perfected and adorned at one and the same time; but in the first place the Navil-vein. 2. The Liver. 3. Afterwards the Heart (which *Aristotle* would have to be first made, as *Galen* would have the Liver to be) and lastly the brain. The Navil-vein therefore, is first finished and perfected, in regard of the enlargement thereof by the blood, but not in respect of its first Constitution of the Seed. But others said that the Groundwork or underwarpe of the Parts is Seed, and the Woof or Superstructure blood, supposing that there are two material Principles of the body: Seed and blood. Which Opinion I have refuted and sufficiently explained in my *Anatomical Controversies, Quæst.* 11. *touching the Parts and their Faculties and Functions.*

Why the Vessels were to be made before the Bowels.

And therefore the Vessels are said in respect of Perfection to be generated before the bowels, and that justly. For otherwise the bowels could not be nourished without a proportionable Instrument to that end, namely a Vein, by which the blood is conveighed for their Nutriment. For as out of a Kernel or Seed put into the Earth, first a long Root descends into the Earth, after that other Roots spread themselves round about the Surface of the Earth, out of which afterwards, the Trunk and branches spring up; so out of the Seed committed to the Womb, there arises first the Navil-vein, receiving blood out of the Womb-cake; out of which Navil-vein arises the *Vena Portæ*, with its Roots.

Let us now come to the Division or Differences of the Parts, which may be divers.

Division of the Parts.

Taking the word in a large Sense, some divide them into parts of *Necessity*, as the Heart, Liver, Lungs, Stomach; and Parts of *Commodity*, and that either *great* as the Eyes and Stones, or *less* as the Nails; and parts of *Ornament*, as the Hairs of the Head and Beard.

In respect of their End.

But I shall divide the Parts, chiefly in respect of their *End*, or in respect of their *Matter*.

In *respect of the worthiness of the End*, some are *Principal*, others less principal and *Subservient*.

The principal Parts.

The *Principal* are the Liver, Heart, Brain, which are the Principles of other Parts. As, out of the brain arise the Nerves, according to the common Opinion, out of the Heart, the Arteries, out of the Liver, the Veins. Others add the Testicles, but without any need, because they make nothing to the Conservation of the Individual, and Generation is caused without them, as I shall shew by Examples in the 7. Book Chap. 22.

The Beginning or principle of Radication.

Now we do not mean the beginning of Radication or Original; for so, the Seed is the beginning of all the Parts, but of Dispensation and Distribution; that is such a beginning as sends out of it self some Instrument, Force or common Matter. So from the Heart, as the beginning

The Original of Dispensation.

or Original of Dispensation, the Arteries arise, because they receive their Virtue from the heart, and seem there to have their Original. The same may be said of the Veins and Nerves in respect of their Originals. So the Gristles have their Original from the bones, and also the Ligaments.

Parts subservient or ministring.

The *Subservient* Parts are *necessary* or *not necessary*.

The *Necessary* are those without which the Animal cannot live, or cannot live well. So the Lungs serve the Heart, the Guts the Stomach; the Stomach the Liver and Spleen; the Gall-bladder, Choler-passage and Piss-bladder, serve the Liver; and all the Instruments of the Senses serve the brain.

The *Not-necessary*, as simple flesh, &c. in respect of other Parts: for in consumptive persons tis wasted away, and in fleshie persons tis a burthen, and insects according to *Aristotle* have no Flesh.

In respect of their Matter.

In *respect of their* immediate *Matter*, *some are* simple, Homogeneal or *Similary*; *others* Compound Heterogeneal, or dissimilary.

A similar part what it is, and how manifold.

A *Similar* Part, is that which is divided into Parts like it self, so that all the Particles are of the same Substance with the whole, as every part of flesh is flesh, &c.

Of such similar Parts, some reckons more, others fewer.

Aristotle in sundry places, thus reckons them: Blood, Flegm, Choler, Sanies or blood-water, Milk, Seed, Gall, Fat, Marrow, Flesh, Veins, Arteries, Nerves, Fibres, Membranes, Skin, Bones, Gristles, Hairs, Nails, Horns, Feathers.

Averroes omits some of these, and adds Melancholy, Spirits, Muscles, Cords, Ligaments, Suet.

Galen in sundry places, thus reckons them: A Bone, a Gristle, a Vein, an Artery, a Nerve, a Membrane, a Fibre, a Tendon, a Ligament, a Nail, Skin, Fat, Marrow, the Glassie and Chrystalline Humors, the flesh of the Muscles and bowels, with the proper substance of the brain, Stomach, Guts and Womb.

Archangelus retaines all the aforesaid, and adds three sorts of Spirits, four Alimentary humors, and the Excrementitious humors, as Urin in the Bladder, Choler in the Gall-bladder, Excrementitious Flegm, and all the Excrements of all digestions, the Scarf-skin, and the internal Skin of the inner Cavities. Moreover, he adds to these, seventeen similar parts, not commonly

ly reckoned, *viz.* the proper ſubſtance (ſetting aſide the other ſimilar parts, Veins, Arteries, &c.) of the Brain, Tongue, Lungs, Heart, Liver, Gall-bladder, Spleen, Stomach, Guts, Kidneys, Ureters, Piſs-bladder, Womb, Yard, Stones, Muſcles, Kernels. But it is in Vain for him to reckon theſe parts as new: for all in a manner are comprehended under Fleſh. For according to *Hippocrates* and *Galen*, there is a fleſh of the Muſcles, and a fleſh of the Bowels, and a fleſh of the Glandules or Kernels. But in another place *Galen* propounds a threefold fleſh. 1. In a Muſcle, which the *Ancients* did only cal Fleſh. 2. The *Parenchyma*, or proper ſubſtance of the Liver, Heart, Kidneys, &c. 3. In the Stomach, Bladder, Veins. 4. In the Bones, though improperly.

How many ſorts of Fleſh there are?

Whence we may gather four ſorts of Fleſh. 1. Muſculous fleſh, which *Galen* frequently terms Fibrous fleſh, and it is ſoft and red and properly termed fleſh. And in *Hippocrates* his Language, by fleſh many times is ment the Muſcles. 2. Viſcerous fleſh or the fleſh of the Bowels. *Eraſiſtratus* cals it *Parenchyma* or an Affuſion of blood; *Galen* cals it Similar and ſimple fleſh, which ſupports the Veſſels of the bowels, fills up the empty ſpaces, and performs the Action. 3. Membranous fleſh, or the fleſhy ſubſtance of every Membranous part, as in the Gullet, Stomach, Guts, Womb, bladder. 4. Glandulous fleſh, or the fleſh of Kernels, which ſerves. 1. For to ſupport the diviſions of Veſſels. 2. To drink up ſuperfluous humors, eſpecially wheyiſh humors, becauſe the Kernels are of an hollow Spungy ſubſtance; and therefore they are vulgarly termed *Emunctories* or Clenſers. Thoſe in the Neck being counted Clenſers of the Head; thoſe in the Arm-pits, of the Heart; thoſe in the Groyns of the Liver. 3. To moiſten the parts for their more eaſie motion, or otherwiſe to prohibit dryneſs. Such are thoſe which are ſituate by the Tongue, Larynx, Eye-corners, &c.

The Number of the Similar Parts.

But the ſimilar parts are reckoned to be *ten*: A bone, a Griſtle, a Ligament, a Membrane, a Fibre, a Nerve, an Artery, a Vein, Fleſh and Skin.

Of theſe ſome are ſimilar only in the judgment of Senſe, as Veins, Arteries (ſome add Muſcles) others are ſimply and abſolutely ſimilar. That Veins, Arteries, Nerves, Muſcles are not truly ſimple and ſimilar, hath been rightly taught by *Ariſtotle*: for a Muſcle conſiſts of Fleſh, Fibres, and a Tendon: Nerves are made up of the Dura and pia Mater, with Marrow: Arteries, of two different coats; the Veins of a coat (and of Fibres as ſome will have it) and Valves. Simply and truly ſimilar parts are Bones, Griſtles, Ligaments, Membranes, Fibres, Fleſh and Skin. To theſe *ſome* add the Ureters, the Air implanted in the Ear, &c. but in vain. For, 1. They are not parts common to the whole body, but proper to ſome parts. 2. The implanted Air of the Ears, is nothing but an implanted ſpirit, which cannot be reckoned among ſolid parts.

Here we are to obſerve that all theſe *parts* are commonly divided, into *Spermatical*, *Sanguine*, or *mixt*.

What a Spermatical Part is?

The *Spermatical* are made of ſeed, and ſuch are the eight firſt reckoned; which if they are cut aſunder, they breed not again, nor can they be truly united, but they are joyned together by a Callus in the middle, by reaſon of defect of matter and formative faculty, which acts not after the Conformation of the Parts.

What a Sanguine Part.

The *Sanguine* or fleſhy Parts, contrarywiſe are bred again, becauſe they are ſuppoſed to be made of Blood, as the Fleſh.

A mixt Part is the Skin, of which we ſhall treat hereafter, in *Book* 1. *Chap.* 2.

For ſeed and blood are commonly accounted the two general Principles of which we are made: ſo that in the Seed there is very little of the material principle, but much of the active, but in the blood much of the material principle, and but a little and weak portion of the active or effective principle. The firſt Rudiments and underwrap as it were of the parts, are ſaid to be made of Seed; and the woofe or ſuperſtructure of blood flowing in. But what the Truth is in Contradiction to this vulgar opinion, we have taught *in our Anatomical Controverſies*. For we are rather to hold, that the parts are at firſt made only of Seed, as of their matter; and that the Mothers blood doth nouriſh, and encreaſe and amplifie the Parts. The Skin in compariſon to other Parts, hath an indifferent proportion of Seed, not ſo much as the Spermatical, nor ſo little as the Sanguinary parts.

What a diſſimilar part is?

The Compound or *diſſimilar Parts* are, thoſe which may be divided into divers unlike parts, as an Hand cannot be cut into other Hands, but into Bones, Muſcles, Veins, &c. The diſſimilar parts are by the Phyloſopher called Members: but they are vulgarly termed *Organical* or inſtrumental parts.

Organical parts.

Now in every Organ, there are for the moſt part, four kinds of parts. For example ſake, in the Eye there is, 1. That part by which the action, *viz.* Seeing is performed, namely the Chryſtalline Humor. 2. That without which it cannot be performed, as the Optick Nerve. 3. That by which it is the better performed, as the Coats and Muſcles of the Eyes. 4. That by whlch the action is preſerved, as the Eye-lids, &c.

And becauſe the Diſſimilar parts are more or leſs Compounded, they are divided into four degrees or ranks.

The 1. Is ſuch as are ſimilar to the ſenſe, as a Muſcle, Vein, Artery. The 2. Is made of the former and the reſt of the ſimilars, as a Finger. The 3. is compounded of the ſecond, as an Hand, Foot, &c. The 4. Is compounded of the third, as an Arm or Leg.

The moſt convenient diviſion of the whole Body of Man.

Finally the *Body is divided* into its greateſt Members, as by ſome into the Head, Cheſt, Belly and Bladder; by others as *Ariſtotle*, *Ruffus* and *Oribaſius* into the Head, Neck, Cheſt (under they comprehend the lower Belly) and therefore *Hippocrates* placed the Liver in the Cheſt] the Arms

Arms and the Legs. But others have better divided them into the *Bellies* and *Limbs*.

The Bellies are certain remarkeable Cavities of the Body, wherein some noble bowel is placed: and as there are three principal Members, so are there *three Bellies*: the *lowest* belly, commonly called Abdomen or the Paunch, contains the Liver and Natural parts. The *Middle* or Chest, containes the Heart and vital parts. The *uppermost* or Head contains the brain and Animal parts. The *Limbs* which were given us for more conveniency of living, are the Arms and the Legs.

This whole Work divided into four Books and four Petty Books or Manuals.

And therefore we shall make four books: 1. Of the Lower belly. 2. Of the Middle belly. 3. Of the supream belly or Cavity, the Head. 4. Of the Limbs. And to these shall answer four *Petty Books*: The *first* of the Veins which arise from the Liver in the lower Cavity. The *second* of the Arteries which arise from the Heart, in the middle Cavity. The *third* of the Nerves, which are commonly thought to spring from the brain. The *fourth* of the bones, which are most what in the Limbs: and as the bones joyned together make a compleat frame and bodies as it were; so also do the Veins, Arteries, and Nerves.

The division of the Body according to the Regions.

We may find another division of the body in *Fernelius*, which nevertheless is of no use save in Physick. He divides the body into *pulpike Regions* and *Private*.

Private Regions he calls the brain, Lungs, Kidneys, Womb, &c. *Publick* or common he makes three extended through the whol body. 1. Hath the Vena porta, and all the parts whereinto its branches are spred. 2. Begins at the Roots of Vena Cava, and is terminated in the smal Veins, before they become Capillary. 3. Hath the Muscles, Bones, and Bulk of the body and ends in the Skin.

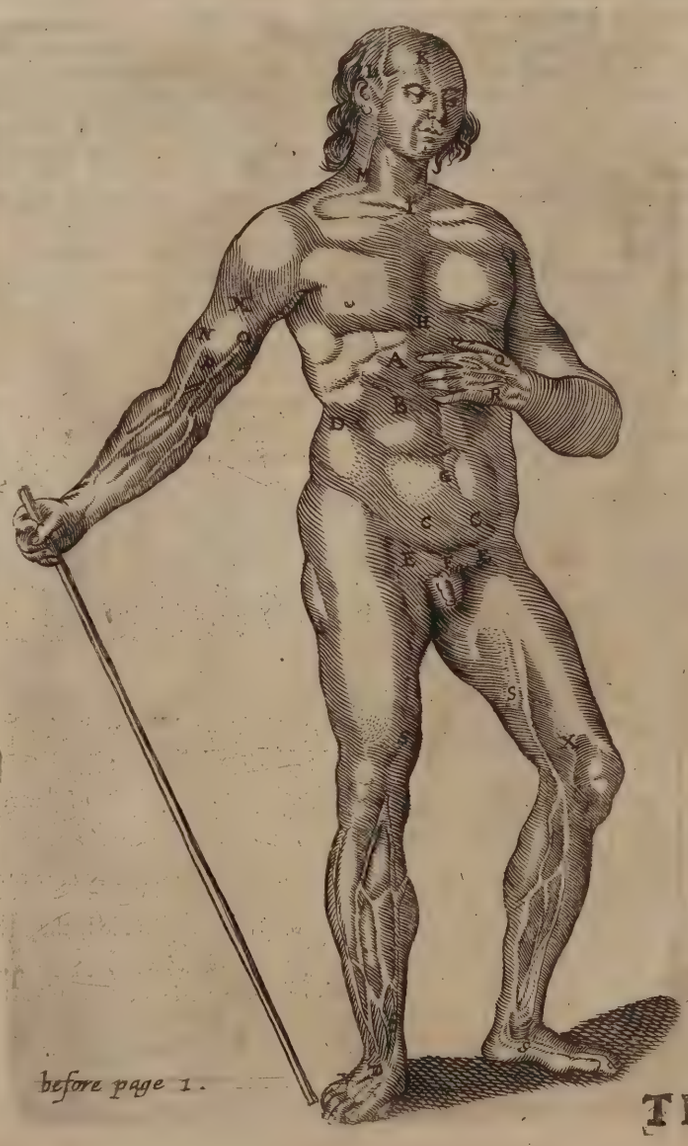
We purge the first Region cheifly by the Guts; The second by the Urinary passages; The third by the Pores of the Skin.

The Explication of the FIGURE.

This TABLE holds forth the Pourtraicture of a Living Man, wherein both the external parts of the Abdomen, as all the Conspicuous Veins which are wont to be opened by Chirurgeons, and the places where Issues are wont to be made, are Represented.

A. *The Hypochondrium.*
B. *The Epigastrium.*
CC. *The Hypogastrium.*
D. *The Flanks.*
EE. *The Groins.*
F. *The Region of the Share.*
G. *The Navil.*
H. *The Heart-pit.*
I. *The jugulum or hollow of the Throat.*
K. *The Forehead Vein.*
L. *The Temple Veins.*
M. *The jugular Vein.*
N. *The Cephalica Vena.*
O. *The Basilica Vena.*
P. *The Mediana or common Vein.*
Q. *The Head vein of the left Arm.*
R. *The Salvatella.*
SSSS. *The Saphena Vein descending.*
T. *The Saphæna Vein in the Foot it self.*
V. *The Vena Sciatica.*
XX. *The place of Issues in the Arm and in the Thigh.*

The I. TABLE



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THE

THE FIRST BOOK; OF THE Lower Belly.

The Reason of the Order. Why Dissection is begun in the lower Belly.

According to the Method of Anatomy, this belly or cavity comes in the first place, and is first of all dissected that the Guts and Excrements may be the sooner removed; and the Body preserved from putrifaction.

What the lower Belly is.

It is all that, which is distinguished, within, from the Chest by the Midrif; it is circumscribed by the sword-like Gristle, the Share bones, Hip-bones, *Os Sacrum*, the *Vertebra's* of the Loynes, and the bastard Ribs on either side.

The Parts of the lower Belly, and their Names.

The former part thereof is called *Epigastrium*, which compasses the stomach and guts next unto it. The Arabians call it *Mirath*, which generally is used for the Belly, but in a particular sence it is taken for those wrinkles of the belly, which remain after child-bearing, and for the skin gathered together upon the belly, as *Giggejus* informs us.

And the upper part hereof is termed *Hypochondrium*, neighbouring upon the lower gristles of the Ribs, and it is right or left: some term them *Phrenes* and *Præcordia*.

The middle Region is termed *Regio umbilicalis*, whose lateral parts *Aristotle* calls *Lagonas* by reason of their Laxity, and *Galen*, *Cenenonas* from their emptyness.

The lower part which reaches from the Navil to the Share, is termed *Hypogastrium*, by *Hypocrates*, *Galen*, *Ruffus*, *Pollux*; the Latins term it *Imus venter* and *Aqualiculus*. The lateral parts thereof, are termed *Ilia*, and in the bending of the thigh by the Share *Inguina* the Groyns; and that part next over the Privities, which is covered with Down or Hair, is called *Pubes* the *Share*.

The hinder part of the lower Belly, is either the upper, which makes the *Loynes*; or the lower, which makes the *Buttocks*.

Moreover this Belly consists of parts covering and covered, that is to say *External* and *Internal*.

The covering or *Containing* parts (which they properly call *Abdomen*) are either common, as the Scarf-skin, the Skin, the Fat with its Membrane, the fleshy Pannicle, and the Coat proper to every Muscle; or proper, and they are the Muscles of the *Abdomen*, and the *Peritonæum*.

The inner or *contained* parts, do serve either for *Nutrition* or *Procreation*.

All the Parts which are to be examined in this Book.

For *Nutrition* or making of Chyle, are subservient more or less, the Stomach, the Caul, the Sweet-bread, the Guts with the Mesentery: to the *making of Blood*, are subservient more or less, the Meseraick Veins, the *Venæ portæ* with their Roots, the *Cava* with its Roots, the Liver, the Gall-bladder, the Gall-passage, the Spleen with the *Vas breve*, and the Hæmorrhoides, the *Arteria Cæliaca* the Kidneys, the *Capsulæ Atrabiliariæ* or black choler boxes, the Ureters and the Piss bladder.

Those which serve for Generation, are either Masculine or Female: the Masculine are, the Spermatick Vessels, the *Corpora Varicosa* or Parastatæ, the Stones, the carrying Vessels, the Prostratæ, the Seminary bladders, the Yard, &c. The Female are, the Spermatick Vessels, the *Corpus Varicosum*, the Testicles, the Ejaculatory Vessels, the Womb with its parts, &c.

But when a Man is in the Womb, there are yet other things considerable, as the Navil-vessels, the coats which infold the Child, &c. of which in their place.

CHAP. I.

Of the Scarf-Skin.

The Scarf-skin.

What it is.

The *Cuticula* or Scarf-skin, in Greek *Epidermis*, is by some called the highest or last skin, also the cream of the skin, the cover of the skin, &c. It is a thin skin void of life and sense, close-compacted, bloodless; bred of Oyly, sleek and clammy vapors thickned by the external cold, that it might be a cover to the skin.

Whether the Scarf-skin be made of seed?

The *Matter* of which the Scarf-skin is made, *is not seed*. For 1. It is no part of the Body. 2. It is not nourished. 3. A Spermatical part taken away breeds not again; but the scarf-skin is easily lost by rubbing and wearing, or being raised into blisters, by burning with Fire or scalding Water, &c.

Or of Blood?

Nor is the matter thereof Blood, For 1. All Veins do end at or within the skin. 2. It hath no spermatical Fibres, which are the basis of all sanguine parts. 3. In long lasting Diseases

and Consumptions, it many times grows thick. 4. Being cut or torne, it sends forth no Blood. 5. It is not of a red color, &c.

Or of the Excrement of concoction.

Nor are the Excrements of any Digestion, the matter thereof. Not the Excrements of the first or second digestion; for how should it be made of Dung, Urin or Gall? Nor the Excrements of the third, For the third Digestion or Concoction hath a threefold Excrement. 1. Vaporous and thin which Expires. 2. Thin, but more solid then the former, of a watterish substance, such as are Ichors and Wheyish humors, which by their sharpness and Acrimony, would sooner hinder the Generation of the Scarf-skin, or corrode the same after it is generated.

Laurentius and Archangelus confuted.

3. Thick, Clammy, and sticking fast, which *Archangelus* and *Laurentius*, do suppose to be dried and turned into the Scarf-skin, and they demonstrate the same from the filth which is, in bathing, scraped from the soles of the Feet. And if their opinion were true, the Scarf-skin would come off in Baths.

The true matter of the Scarf-skin.

And therefore the matter thereof is *another Excrement*, viz. an Oyly, Thick, Clammy, and moist vapor (for of dry Exhalations the Hair is made) proceeding from the Skin and Members under the same. So we see in a Skillet of Water-gruel, a Skin grows over the top of the Gruel, being mad, of the vapors thereout ascending, condensed by cold.

Now the Scarf-skin is *bred*, partly in the womb with the Skin, and partly without the Womb. Within, For 1. So there are the rudiments and beginnings of Hair, Teeth, Nails in the Child in the Womb, 2. Without the Scarf-skin, the skin would be moist, and the Humor would sweat out with pain, as in gallings and where *Phoenigmi* are applied. 3. Experience shews, that the Scarf-skin is somewhat apparent in an Abortion, and may be separated by some fretting Humidity. But whiles the Child is in the Womb, it is exceeding tender, soft, and but as yet begun to be made: because there is not in the Womb so much cold, only a small degree springing from the serous humor which surrounds the Child. But it receives its Complement and perfection without the Womb, from the coldness of the Air, which doth more condense and dry, which is the Cause that the skin of all New-born Infants looks red.

The Efficient Cause thereof.

Wherefore the remote and internal *Efficient* thereof is in the inward heat of the Body, thrusting forth a vapor into the surface thereof, as Exhalations are made by the suns heat. The next and external, is the coldness of some body, as the Air, &c. compacting, and thickning. So Gruel, Hot milk, and other hot dishes of meat, have a skin growing over them: sometimes also the dryness of the Ambient Air, consuming the external humor, and compacting the remainders of the matter. Now by how much the said vapor is more Earthy and Clammy, by so much more solid is that which is bred thereof.

Use.

The *Use* thereof is to defend the Skin. And therefore 'tis somwhat *hard*, howbeit *exceeding thin* and yet transparent, like the transparent skins of Onions; least if it were thicker, the skin should not feel aright. Yet it is sometimes *hard* and *brawny*, in the Hands and Feet by reason of Labor and Travel.

'Tis close wrought and more compact than the Skin. And therefore it is that watery pustules pass through the Skin but not the Scarf-skin. Yet not over close and compact, least it should hinder the bodies transpiration. And it is close wrought, not only to defend the parts under it but that also too great an efflux of Vapor, Blood, Spirit and heat might not happen. For it is the cover of the Mouths and extremities of the Vessels. And therefore those cannot live in good health that are born without a Scarf-skin; as was seen in *Lewes* the King of *Bohemia* and *Hungaria*, who became gray hair'd while he was but a Boy.

The color of the Scarf-skin.

It is of a *white color*, and therefore of a *cold and dry temper and quite void of Blood*, For being torn or cut, it sends forth no Blood. Nor is it nourished by Blood, as *Lauremberg* and *Sperlinger* would have it; for it is not intrinsically nourished by attraction of its proper Aliment; but by addition of parts, the vapor growing into the like nature of the Scarf-skin, as *Casserus* rightly disputes. The Scarf-skin is black in Blackmores, but not the skin beneath it.

Its number.

As for *number*: there is but one Scarf-skin; only there was once two found by *Aquapendent*: the one being strongly fastned in the pores of the skin, and inseperable; the other seperable without offence to the skin. Which happens in some only, not in all parts of the Body. Also *Laurembergius*, in applying Vesicatories, found the Scarf-skin double; but that is a rare case, for that Vesicatories do peirce unto the skin is apparent from the humor dropping out, and the pain. In brawny Callosities, indeed there are many little skins, as it were the skins of Onyons; but they are besides nature, whose Generation and cure is delivered by *Fallopius*.

Its Connexion.

In point of *Connexion*, it sticks so close to the Skin of a man, while he is alive, as if it were one continued body therewith. Yet many times it is cast off as snakes and serpents cast their skins, which *Felix Platerus* tells us did happen to himself; and which happens in burning Feavers and the small Pox. *Salmuth* observed as much in some Gouty persons, in an Ague, and some other cases. In dead persons 'tis separated by a Candle, or scalding Water: in living Bodies with *Phoenigmi*. In the Nut of the Yard, it sticks not to the skin, but to the flesh.

CHAP. II.

Of the Skin.

What the Skin is?

CUtis, the skin, is in Greek cal'd *Derma*, as it were *Desma* a band; it is the common covering of the Body; or a Temperate Membrane bred of the seed by a proper faculty, to be the Instrument of feeling, and to defend the parts beneath it.

It is called a *Membrane*, which must not be understood simply, but so as to be a Membrane of a peculiar nature and proper temperament. And therefore *Piccolhomineus* was mistaken when he would have the skin to be simply a Membrane; for the skin is thicker, hath a substance proper to it self, and is temperate.

Piccolhomineus refuted.

Galens *Opinion touching the matter of the skin.*

But the opinion of *others* is, that the *matter* hereof is Seed and Blood well mixed together, so that the skin hath a middle nature between Flesh and Nerves. And therefore *Galen* sayes, that it is as it were a Nerve endued

endued with blood: he sayes not simply, but as it were. For he also likens it to a Membrane, because in some parts it may be extended, feels exquisitely, and is white.

Aristotles Opinion. *Aristotle* would have the skin to consist of flesh dried and grown old as it were. But the skin is easily flaid from the parts under it, and between the flesh and skin there is fat, a Membrane, &c. to which Opinion *Fernelius* inclined, when he said that the skin of the Face was a certain more dry portion of the flesh beneath it. Wherein he also is to be blamed, Because 1. It may be separated from the flesh. 2. It will admit of Scars as the skin in other places.

The Opinion of others. *Others* say it is made of the Extremities of the Vessels widened, because it every where lives and feels, and the extremities of the Vessels end thereinto: but this may be said of all the parts of the Body.

Others, of the softer Nerves spread out in the surface of the Body, an addition of blood concurring: but this Opinion is of no more force then the former.

The true matter of the skin. The skin therefore is made of Seed taken in a moderate quantity: and for its enlargement, it had a moderate quantity of blood; but seed seems to hold the greater proportion. For the skin is naturally whitish; though it varies according to the plenty of humors and Bodies beneath it. For such as the Humor is, such will be the color of the skin. So Sanguine persons have it ruddy; those that are Jaundized, have it yellow or black. Examples whereof see in *Marcellus Donatus* and others. If flesh lie beneath it, the redder it is, if fat the whiter.

A Scar, what it is? It is in respect to the seed, that Authors say, the skin grows not together again after it is wounded. In respect of the blood, there is somewhat like the skin produced, viz. a Scar: Which consists as it were of burnt and dried flesh. Howbeit in Children, by reason of the moisture of their skin, as also the abundance of glutinous humors, a wound hath been observed to be closed up with true skin; *Witness Spigelius.*

Wherefore the skin being made as it were of a Membranous, cold and dry, and of a fleshy, hot and moist substance; becomes temperate in all the first and second qualities, that it may rightly judg of all.

The efficient cause of the skin. The *Efficient* Cause of the skin, is the Skin-generating faculty; as in a bone the Bone-generating faculty, in a Nerve the Nerve-forming power or faculty, &c. which faculty frames a part differing from all other similar parts. But how doth the faculty make of the same Seminal matter Nerves, Bones, &c. by an hidden and divine power as it were.

The Action of the skin. The *publick Action* of the skin, and which is necessary for the whole Living-Creature is, to be the primary Instrument of the sense of feeling, for every Membrane is the Adæquate Organ, as may be seen in the Bones, Nerves, Stomach, &c. For though all the Organs of the senses are dissimilar parts, yet one similar part is the primary cause of the action, which is to be performed by the whole Organ. For examples sake, the hand is indeed the Organ of feeling, and especially that part of the skin, which covers the hollow of the Hands and Feet, as being of all other most temperate. And because the skin is temperate in the first qualities; it is therefore also temperate in the second, as softness hardness, thickness, thinness, &c.

Its Use. *The first use of the Skin is, to be* a Covering for the Body, and therefore it hath received a *Figure* so round, long, &c. as the subject parts required; and therefore also it is seated without the Body, and because it was to be as it were the Emunctory of the Body. The professors of Physiognomy commend unto us another use of the skin, as it is streaked with lines; who are wont to tell mens Fortunes from the Lines and Hillocks in their Hands, and from the Planetary and Adventitious Lines in their Foreheads. A *third* use is Medicinal, being good for Anodine Emplasters. Being dried, it helps women in Labor; Epileptick Convulsions, according to the experience of *Hildanus* and *Beckerus*; Wounds of the Scul, according to *Poppius*. The *fourth* is more illustrious, that it might give way to Excrements, and exclude insensible sooty Fumes by way of insensible Transpiration, by which we are more disburthened then by all our sensible Evacuations put together. By this, *Sanctorius* through the statick Art, in the experience of thirty years, did learn that many persons in the space of one natural day, do void more by transpiration, then in fifteen dayes together by stool. The *fift* is to attract. 1. Air in transpiration, in Apoplectick and Hysterical fits, and in such as dive deep and bide long under the Water. 2. Juyce, in long fasting, from plasters applied, if we credit the Observations of *Zacutus Lusitanus*; and the force of purgative and other external Medicaments. And for this cause.

'Tis bored through in divers places, for the ingress and egress of things necessary. Now its holes are some of them visible, as the Mouth, the Ears, the Nostrils, &c. others invisible and insensible, as the pores. Those pores of the Body, being otherwise not Conspicuous, are seen in the winter, when the Body is suddenly bared; for then the Scarf-skin looks like a Gooses skin when the feathers are pul'd of. By reason (it seems) of these pores it was, that a certain *Persian* King made use of the skins of Men for windowes, if we may credit *Orabasius*.

The Skin is *thick*, six fold thicker then the Scarf-skin, but thinner then it is in other Animals, nor must any one judg of the thickness of the Skin after it is made into Leather, for by Tanning it is much contracted and thickned, And it seems to be made lighter, for a Mans skin Tanned according to the Observation of *Loselius*, weighs four pounds and an half.

It is *soft* and exquisitely sensible, but softer and thinner in the Face, Yard, and Cods; harder in the Neck, Thighs, soles of the Feet, Back; of a midling constitution between hardness and softness, in the tops of the Fingers. So, some part of the skin is extream thick as in the Head, according to *Aristotle*, falsly cited by *Columbus*. Some is thick, as in the Neck; some thin as in the sides, whence proceeds tickling; some yet thinner as in the Palms of the Hands, some thinnest of all, as in the Lips. In Children 'tis more thin and porous then in grown persons, in women then in men; in an hot Countrey, then in a cold. Also the Skin is more rare and open in the Summer then in the Winter; and therefore it is that the skins of Animals flaid off in the Summer do more hardly retain their hair, then such as are flaid off in the winter. Also it varies very much according to the diversity of the subject; so that in some it hath been of an admirable density and thickness, if we beleive *Petrus Servius*, who tels of two Negro women, that could without hurt take up, carry, hold, and almost extinguish burning coles with their bare Hands. *Fallopius* saw the skin of a fat man so thickned, that he lost his feeling, by reason of the over-great covering of the Nerves.

As

Its Connexion. As to its *Connexion*: some skin is easily separated from the parts under it; as in the lower and middle Belly, in the Arms and Thighs. From others with more difficulty by reason of the thick Membrane to which it is fastned by the Fibres, and by means of the Vessels. In the soles of the Feet and Palms of the Hands, it is hardly separated, to which parts it grows that they might lay the faster hold. Also hardly from the flesh of the Forehead and of the whole Face, especially of the Ears and Lips, by reason of tendons and Muscles mixed therewith, especially the Muscle *Latus* so called, mingled therewith. So, in the Forehead it is moveable, and in the hinder part of the Head of some People by reason of peculiar Muscles; but it is not so in the rest of the Body.

Its Vessels. The skin hath received common Vessels, for Nourishment, Life and Sense. It hath received two cutany Veins, through the Head and Neck, from the Jugulars; two through the Arms, Breast and Back, from the Axillaries; two through the lower Belly, Loyns and Legs, from the Groyns, which are Conspicuous in women after hard Labor, and in such as have the Varices in many branches. It hath few *Arteries*, And those very small, in the temples and Forehead, Fingers, Cod and Yard. It hath no *Nerves* creeping in it, but it hath many ending in it, as *Galen* conceived: though *Iohannes Vestingus* the prime Anatomist of *Padua* sayes there are very small branches of Nerves running through the skin; and that rightly, for their presence was necessary to cause the sense of Feeling.

CHAP. III.

Of FAT.

What fat is? FAt is a similary Body void of Life, growing together out of Oyly blood, by reason of the coldness of the Membranes, for the safegard of the whole Body. That it is void of Life, appears in that it is cut without pain, and Consumptions thereof shew as much. Therefore *Plny* writes that living sowes are gnawn by Mice; and *Ælian* reports that the Tyrant *Dionysius* was so Fat, that when he was a sleep, the pricking of Needles could not awake him. Also in *Greenland* they cut fat out of living Whales which they never feel nor perceive.

The difference between Pinguedo *and* Adeps. *Pinguedo* fat, which the Greeks term *Pimele*, is by *Gaza* ill translated *Adeps*: for *Pinguedo* is an Aiery hot and moist substance of the moister sorts of Animals, and is more easily melted with heat, and will scarce ever become hard again, nor can it be broken, and it is soft, laxe and rare: but understand the contrary in Suet, which easily grows hard and stiff, but is hardly dissolved, &c.

Fat is not a part of the Body. Now fat to speak properly, is not a part, but rather an humor, unless haply it be considered together with the Membrane, as many times it is by *Galen*.

The reason of our order is this; because fat in a man is between the skin and the fleshy Membrane, in Brutes it lies under the Membrane which moves the skin.

what parts have Fat, and what not. Those parts are void of fat, which could receive no profit thereby but hindrance by resisting convenient Complication and Distension, as the Brain, Eyelids, Yard, Cod, and Membranes of the Testicles. Now it is chiefly in those parts which are more strongly moved then the rest, hard like Suet, and interwoven between the Fibres and little Veins, as in the Palm of the Hand, the inner sides of the Fingers (for there are many tendons, Nerves and Vessels, which ought to be moistened) in the sole of the Foot, especially the Heel. It is softer in sundry parts, of which in their place.

It is not made of Chyle. *Cæcilius Folius* hath lately written that the matter whereof fat is made, is the milky juyce, or fatter portion of the Chylus, and that therewith the Bones are nourished. To which opinion I oppose. 1. That such as eat fat meats, do not presently grow fat. 2. That the Chylus is too crude to nourish the parts. 3. That Children should presently become fat as we see it happen in Children new born, who have been nourished only with their Mothers Blood. 4. That the Chylus is necessarily changed before it come unto the Parts. 5. There is no passage from the Mesentery to the extream parts of the body; for it is neither suckt through the Membranes, as some learned men suppose, nor is it carried through the Glandules. Not the former. 1. Because they are thicker, then to suck and draw as threads. 2. They would appear swoln, and would in Anatomy discover some Oyly moisture in them. Nor the latter, 1. Because the Kernels are not continued with the fat parts. 2. Nor do they receive any profitable humor, but Excrements, yea they abound with a white, flegmatick, but not a fat humor. 3. We observe that many creatures grow fat which have no Kernels. Now the fatter part of the Chyle is the material cause of fatness, but it is only the remote cause, and therefore in deed and truth,

But of Blood. The *Matter* thereof is Unanimously concluded to be *Blood*, whence *Aristotle* sayes, that such Creatures as have no Blood, have neither Fat nor Suet: but it must be blood *Purified* and *Absolutely concocted*, nor yet all such blood, but that which is thin, Aiery and *Oyly*. It resembles the buttery substance of Milk, and the Oyly substance of Seed; and therefore *Aristotle* did well deny Fat to be moist; with a watery moisture, his meaning was, not with an Aiery. Against whom *Fernelius* and *Columbus* have written. And when fat is made of Oyly Blood, much of the heat is lost. Whence *Aristotle* sayes; *Such things as are condensed by cold, out of them much heat is forced and squeezed.* And in another place: *Natural matters are such, as the place is wherein they are.*

That blood is Aiery and oyly

Fat is colder then Blood, yet moderately hot. Therefore the nature of Fat is colder then that of blood, yet is it moderately hot; For 1. Outwardly applyed, it Digests, Resolves, Discusses. 2. It is the thinner and more Oyly part of the blood. 3. It easily takes fire. 4. It encreases the heat within, as the Caul assists the Stomachs Concoction, &c.

Some will have it to be cold, because *Aristotle* sayes, whatever things grow together by cold, and are melted by Heat, are cold. But Fat is congealed by cold. I answer: Fat is cold in respect of the Heat which before it had, while it was blood. But we must learn from the same *Aristotle*, that such things as having been congealed by cold, are melted with an easie Heat, have not lost much of their Hotness.

The

Vessels, and Skin, and consequently renders the Body smooth, white, soft, fair, and beautiful. And therefore persons in a Consumption and decrepit old Women are deformed, for want of Fat.

CHAP. IV.

Of Membranes in General, of the fleshy Membrane, and the Membrane which is proper to the Muscles.

The fleshy Membrane, its situation.

UNder the fat in a Man, the *Membrana carnosa*, or fleshy Membrane lies, which in Apes, Dogs, and Sheep lies next the Skin. Before we treat thereof, some things are to be known concerning the Nature of a Membrane in general.

The Ancients called the Membranes *Hymenas*, and sometimes *Chitona's* Coats, also *Meningas*; and otherwhiles *Operimenta*, and *Tegumenta* Coverings; and with *Galen* and other Anatomists, speaking in a large Sense, a Coat and a Membrane, are one and the same thing. But when they speak in a strickt and proper Sense.

The difference between a membrane and a Coat, and Meninx.

That is a *Membrane* which compasses some bulkie Part, as the Peritonæum, the Pleura, the Periostium, the Pericardium, and the peculiar Membranes of the Muscles.

But the term *Tunica* or Coat in a strickt sense, is attributed properly to the Vessels, as Veins, Arteries, Ureters, the Womb, the Gall-bladder, and the Piss-bladder, the Gullet, the Stomach, the Guts, the Stones.

The term *Meninx* is properly given and peculiarly to the Membranes of the Brain.

What a Membrane is?

Now a Membrane is a similar part broad, plane, white, and which may be stretched, made by a proper Membrane-making faculty, of clammy and watery Seed, to the end that it might by cloathing defend the Parts.

The Form thereof is the equality of its Surface, Thinness, and Lightness (least it should burden) compactness and strength that it might be widened and stretched.

Its Use.

Its Use is 1. To cloath and defend the Parts by reason of its hardness and compactness; and to be the Instrument of feeling: For the Parts feel by help of the Membranes. And so great is the necessity of Membranes, that Nature hath covered every Part with a Membrane. 2. To strengthen the parts. 3. To defend the parts from the injury of the Cold, and to keep the Natural Heat from exhaling. 4. To joyn parts with parts. So the Mesentery knits the Guts to the Back. 5. To shut the mouths of the Vessels, least the Humors should flow out, or flow back: As in the Bladder, where the Ureters are implanted, in the Ventricles of the Heart, by the Valves.

The Difference of Membranes.

Now a *Membrane* is *thicker* or *thinner*.

The *thin* Membrane differs in thinness. For the Periostium of the Ribs is thinner then the Pleura, the Periostium of the Head, is thinner then the Pericraneum; the *pia mater* is thinner then the *dura mater*.

The *thick Membrane* is the *Membrana carnosa*, which is not every where alike thick; for it is thicker in the Neck then other places. And now let us speak of the *Membrana carnosa*, or fleshy Membrane.

The fleshy Membrane what for a thing it is?

The *Panniculus carnosus* or *Membrana carnosa* is by some termed a membranous Muscle, by others a Nervie Coat, a fattie Coat, &c. It is termed fleshy, because in some places, as about the Forehead, the compass of the Neck, and the Ears, it turns to a musculous flesh, and in such Creatures as by the help hereof can move their whole Skin, it seems to be a Muscle: It is endued with such fleshy Fibers, especially in their Necks, by the motion whereof they drive away flies. But in Man, save in his Forehead, it is immoveable; only *Vesalius* and *Valverda* report that there were some men who could move the Skin on their Chest and Back, and in other parts, just as oxen do. In whom doubtless this Membrane was made of the same constitution, which it hath in Brutes. Moreover in new-born Children, it resembles flesh, by reason of plenty of blood: in grown persons it is like a Membrane, by reason of continually being dried. In a Mans Body, if exact Separation be made, it will appear to consist of four distinct Membranes. *Spigelius* and others do take those membranous Fibers, which are every where interwoven among the Fat, to be *Panniculus carnosus*, or *Membrana carnosa*.

Its Use.

Its *Use* is 1. To defend the neighboring Parts, yea, and to cover and defend the whole Body, and therefore it is situate all over the body.

2. To keep in the Fat, that it flow not out, or melt by reason of the continual motion of the Muscles.

Connexion.

3. To support those Vessels which are carried into the Skin (which go between the Skin and this Membrane) for it is *knit unto the Skin* by very many Veins, some fewer Arteries, branches of Nerves, and membranous Fibers; and to the Membranes under the Muscles, by the smaller Fibers. It is therefore false, that when the Fat is consumed by fasting, the Skin sticks to the Muscles no otherwise, then a Ball to a peice of cloth wherewith it is covered. It sticks most firmly to the Back, in fashion of a Membrane, and therefore it is said to arise from thence. In the former part of a Mans Neck and his Forehead, it can hardly be separated from the Skin and the *Musculus latus*; it sticks so close, and is thought to constitute the *Musculus latus*.

Original.

The *Surface* thereof is slippery, there where it touches the Muscles, by reason of that clammy Humor, which is wont to be daubed upon the Membranes, least the motion of the Muscles should be hindred. It is of exquisite sense; and therefore if it be twitched by a sharp Humor, it causes shivering and shaking, as by Choler in Agues.

The Membrane of the Muscles, what?

The proper Membrane of the Muscles, which some will have to spring from the Pericranium or Periostium, others from the nervous Fibers of the Muscles, is thin, and is knit unto the Muscle, by most thin filaments.

Its Use.

Its *Use* is 1. To cloath the Muscles, and separate them one from another. 2. To impart unto them the Sense of feeling.

CHAP.

CHAP. V.
Of the Muſcles in General.

A Muſcle is termed in Greek *Mus* a Mouſe, becauſe it reſembles a flaid Mouſe; and the Latins cal it *Lacertus* a Lizard, from its ſimilitude with that Creature: Howbeit we cannot allot one certain figure to the Muſcles, by reaſon of their variety.

What a Muſcle is? A Muſcle is an Organical Part, the Inſtrument of voluntary motion. For only this part can receive the Influx of the motive faculty. *Helmont* allowes the muſcles a life peculiar to themſelves, which continues for a while, even after death, as the convulſive motion in the Falling-ſickneſs which continues involuntarily. Which nevertheleſs does more truly ariſe, from the retraction and drineſs of the Nerves, and defect of Spirits. Alſo the ſame man is in an error in conceiving that new fibres do ariſe in the muſcles, and cauſe the Palſie. No man ever ſaw them, nor can they be bred anew, becauſe they are Spermatick parts. The Palſie ought rather to be referred to a defect of ſome fibres.

A Muſcle is an Organical part. A muſcle is an Organical part, becauſe it conſiſts 1. Of fleſh. 2. Of a tendinous part (and theſe are the two parts of a muſcle, which perform the Action) 3. Of Veins to carry back the Nutriment. 4. Of Arteries preſerving the inbred Heat, and bringing the Nouriſhment to the part. 5. Of Nerves, which contribute ſenſe and eſpecially motion. For the Brain ſends the motive faculty through the Nerves into the Muſcles. 6. Of Membranes which encompaſs and keep the muſcles together. 7. Of Fat which moiſtens them, and hinders them from being dried by over much motion.

The Connexion of the Muſcles of the whole Body. The Muſcles of the whole Body are moſt ſtraitly conjoyned one with another: Yet ſometimes they gape, and are at ſome diſtance, when Wind, wheyiſh Humor, or ſome other matter gets between them; as in the baſtard Pleuriſie, and concerning a Soldier whipt by the Turks. *Veſlingus* told me that his muſcles were ſo widened and ſeparated, that if he bent his body but a little, every muſcle would bear it ſelf out from its Natural ſituation, bunching out as it were, and ſwelling.

The Parts of a Muſcle only two. We divide the Muſcles into two *parts*, a *fleſhy* part, and a *tendinous* part.

The tendinous Part how many fold. Again, we make the *tendinous* part to be either *united*, or *diſgregated*, and *ſevered*.

United, where the whole tendinous part appears, white and hard, either in the beginning, end, or middle; or in all theſe parts.

Contrariwiſe it is *diſgregated* or *ſevered*, where it is divided into many ſmall fibres, ſcarce diſcernable to the ſight, being compaſſed about with fleſh; which tendinous fibers may notwithſtanding be diſcerned among the fleſhy ones, in boyled Hogs-fleſh, and in the fleſh of a Turkey-cock, &c. So in ſome Muſcles, eſpecially thoſe of the Thighs of a Turkey-cock, the tendinous parts appear whole and united from the beginning to the end. So in a man, ſomtimes the Tendon deſcends preſently after its Original, mixed with fleſh. Somtimes the tendinous part appears, united in the end, and ſevered in the beginning, as in the muſcle Deltoides; ſomtimes it is tendinous in the middle, and ſomtimes not at all.

What the Tendon of a Muſcle is? With *Aquapendent* we define a Tendon to be a Body continued from the beginning to the end of a Muſcle, and that it is a body of a peculiar Nature, cold and dry, made of Seed, as the principle of its Generation: But the beginning of its diſpenſation is a bone, for it ſprings from a bone, and is inſerted or implanted into a bone. Yet ſome Muſcles ariſe from Griſtles, and ſome from Tendons, and are implanted into them. And it is rightly termed *Tendo*, from ſtretching, becauſe it is bent and ſtretched like the ſtring of a bow.

Its Beginning.

Why called Tendo?

A *Muſcle* is otherwiſe divided into the *Head*, *middle*, and *End*.

The Beginning and Head of a Muſcle. The *Beginning and Head of a Muſcle*, when it is tendinous, is by *Galen* and other Anatomiſts, called *Ligamentum*, which they ſay is void of Senſe, and that it is leſs then a Tendon, or the end of a Muſcle.

Both the beginning and end of a Muſcle may be called a Tendon. Now the beginning in a great part of Muſcles, is tendinous, ſeldom fleſhy. And to ſpeak the very truth, the beginning may as well be termed a Tendon, as the end; ſeeing for the moſt part, ſuch as is the Beginning, ſuch is the End, in Subſtance, in Thinneſs, Lightſomneſs, Whiteneſs, &c.

Two things obſervable touching the beginning of a Muſcle. Now every Muſcle is ſaid to move towards its beginning, and every Muſcle hath a Nerve, which is inſerted either into the Head, or about the middle (and in ſome through the Surface of the muſcle, in others through the Subſtance) ſo that where the Nerve is implanted, there is the Head of the Muſcle: Which *Galen* laies down as a ſure Rule, and ſaith; that if the Nerve be implanted into the Tayl, there is the Head of the muſcle. But *Johannes Walæus* an excellent learned Phyſitian, likes not this Ruſe, and conceives that it is all one, whether the Nerve be inſerted into the beginning, the middle, or the end. 1. Becauſe that Rule renders the motions of many muſcles obſcure. 2. Becauſe it holds not true in the Pectoral muſcle, nor ſomtimes in other muſcles of the Cheſt and Belly. 3. Becauſe that Rule is not founded upon any reaſon, for whether the Nerve be inſerted into the beginning of the muſcle, or into any other part thereof, the Spirits flowing in by the Nerve, may equally move the muſcle: As we ſee in Wind-Inſtruments, the Air is let in ſomtimes above, ſomtimes beneath, one way as conveniently as another. 4. And whereas that Rule is oftentimes found true, it happens by accident, becauſe moſt muſcles are moved upward, & becauſe the Nerves deſcend from above, and therefore could not be more ſafely implanted any where, then in the upper part of the muſcles. And that which *Riolanus* objects againſt *Walæus*, touching the Contorſion or Wreathing of the recurrent Nerve, is nothing. For the Nerves run back, to avoid confuſion, otherwiſe, if Nature chiefly intended the Inſertion into the Heads of Muſcles, ſhe might have

Galens *Rule.*

Diſliked by Walæus; *and why?*

The Objection of Riolanus *anſwered.*

is proved by the common Action, of which beneath.

The Uſe [according to *Riolanus*, who ſaith that the *Os pubis* or Share-bone being moveable, doth move this boney ſtructure forwards, the Cheſt reſting, or being lightly moved, in the Conjugal Embracement, and in the going of ſuch as want Leggs and Thighs. But we daily obſerve the Belly to be moved, in ſingle perſons that are chaſt, nor doth Nature frame Parts to ſupply unexpected defects of muſcles, but for Natural and Ordinary Actions. *Spigelius* ſuſpects, that from the ſame moveable beginning, that ſame bone is drawn obliquely upward, and enclined toward the Cheſt, by the help of the muſcles.

The *ſecond pare* is the OBLIQUELY ASCENDENT [or internal] having Fibres contrarily ſituated: It is ſituated next the former, and hath a triangular Figure.

The Original of the obliquely aſcendent Muſcles. Its *Original* is fleſhy, from the Rib of *Os Ilij*: but membranous, both from the tranſverſe Proceſſes of the Vertebra's of the Loins, from which it receives Nerves, and from the ſharp points of *Os ſacrum*.

Their double End. It grows a little by a fleſhy End, to each of the baſtard Ribs, and to ſome of the true Ribs, but the reſt its End turns by little and little into a Tendon, which is double: The one part goes upon the right muſcles, the other beneath, ſo that the right doth reſt as it were in a ſheath, but near the white Line it is reunited, and inſerted thereinto. Which *Riolanus* hath obſerved to happen only above the Navil, and not beneath.

The third pare of the *right Muſcles*, by reaſon of the right fibres. This pare is commonly reckoned to be but one.

The Original of the right Muſcles. *Galen* doth rightly make the beginning to be fleſhy, ariſing from the Breaſt-bone, on each ſide of the Sword-faſhion'd Griſtle, and from the Griſtles of the four baſtard Ribs. It *ends* in a Tendon at the *Os Pubis*. Others contrariwiſe, will have the beginning to be here in the Share-bone, and the End above. But I anſwer. 1. That the right Muſcles receive their Nerves in the upper part, viz. one branch of thoſe Nerves, which were inſerted into the oblique deſcending Muſcle, and others alſo from the laſt of the Back, and from the firſt pare of the Loins. 2. A Muſcle uſes not to have a tendinous beginning, and a fleſhy End. Other late Anatomiſts will have the right Muſcles to have two beginnings and two ends; one beginning and one end in the Breaſt, and another in the Share-bones. Who are for this Conceit of theirs, beholden to that new opinion touching the moveableneſs of the Share-bone, of which I ſhall ſpeak hereafter.

That there are divers right Muſcles. The *Muſculus rectus* or ſtraight muſcle, hath for the moſt part three. Inſcriptions in Perſons of a middle ſtature, and ſomtimes four in tall people, whoſe Belly is long. But according to *Carpus* and *Caſſerius*, we ſay that ſuitable to the multitude of Inſcriptions, there are more muſcles, becauſe 1. To every Joynting there comes a Nerve. 2. If it were but one, being contracted into it ſelf, it could not equally compreſs all parts. 3. There ſhould be no ſuch muſcle in the whole body, wherein nevertheleſs there are many long ones, without ſuch a number of Inſcriptions.

In the internal Surface of the right muſcles, there are *two Veins* conjoyned, with as many Arteries.

The Veins. The *upper* called *Mammaria*, ariſe from the *Vena cava*, lying beneath the Claves, the more remarkeable branch whereof reaches unto the Duggs, and runs out under the right Muſcle, as far as to the Region of the Navil, where it is terminated.

This is met by the other termed *Epigaſtrica*, which in Women ſprings from the Womb, in men the *Vena cava* goes upwards towards the upper Vein, which before it touches, it is for the moſt part obliterated. Yet theſe two Veins are ſomtimes joyned together by manifeſt Anaſtomoſis, touching one another, at their ends. Hence the Conſent is ſuppoſed to ariſe between the Duggs and the Womb, the Belly and the Noſtrils. For when the Noſe bleeds, we fix Cupping-glaſſes to the belly, and the Duggs of Women being handled, it incites them to Venery.

The Arteries and Nerves. The *Muſculi recti* receive *Arteries* from the Epigaſtrica Artery, and *Nerves* which proceed from the laſt Vertebra's of the Cheſt.

The proper uſe of theſe Muſcles according to *Riolanus*, is to move the Share-bone forward in Generation, which hath been already confuted. *Spigelius* will have them to draw the Breaſt to the *Oſſa pubis* or ſhare-bones, and the Share-bones to the Breaſt, in a ſtraight motion, and ſo to bend the Cheſt; whence it is, that in Dogs and Apes, they reach as far as to the *Jugulum*, becauſe their Cheſt did require very much bowing. But theſe contrary motions, unleſs they be holpen, with thoſe inciſions of the right muſcles, do involve a difficulty. *Helmont* ſuſpects that they are ſtretched in going up hill, and that from thence ſhortneſs of breath proceeds. *Flud* ſaith, that by a general uſe, they make the Belly round, and compreſs it centrally, or towards the middle point thereof.

The Pyramidal Muſcles. The *fourth pare* called the *Pyramidal* Muſcles, do reſt upon the lower Tendons of the *Muſculi recti*. Nor are they parts of the right Muſcles, as *Veſalius* and *Columbus* think; but diſtinct muſcles, as *Fallopius* proves with reaſons, which are partly convincing, partly vain. But that they are peculiar muſcles is hence apparent. 1 Becauſe they are cloathed with a peculiar membrane, 2. Their Fibres are different from thoſe of the *Muſculi recti*.

Their Original. They *riſe* with a fleſhy beginning, not very broad, from the external Share-bone, where alſo the Nerves do enter; and the farther they go upwards, the narrower they grow, till they terminate with a ſharp point, into the Tendon of the tranſverſe Muſcle. And from this place I have obſerved more then once, a ſmall and round Tendon produced, as far as to the Navil.

Riolanus hath obſerved the left Pyramidal Muſcle to be leſſer then the right, and when there is but one, it is oftner left then right.

Their Uſe. The Uſe of the Pyramidal Muſcles, is to aſſiſt the right muſcles, in compreſſing the Parts beneath. Hereupon according as the Tendons of the right muſcles are more or leſs ſtrong, ſo, ſometimes the Pyramidal muſcles are wanting (though rarely) ſomtimes they are ſtrong, otherwhiles weak, and ſomtimes there is but one. *Bauhine* ſaith: If they are abſent, then either the fleſh joyned to the Heads of the right ones [which I have often obſerved] or the Fat performs their Office. And others will have them to be as it were certain Coverings of the right muſcles.

Fallopius will have the Pyramidal muſcles, to compreſs and ſqueez the Bladder, when we make Water, that the Urin may be forced out. Contrariwiſe *Aquapendent* will have it, that they raiſe and lift themſelves up, and together with them the Abdomen and Perito-

næum, that the parts beneath them, may not be too much burthened. Now *Columbus* charges *Fallopius*, that he would have these muscles serve to erect the Yard, whereas that is *Massa* his Opinion [whose Opinion is followed by *Flud*, because of the situation of these Muscles] but they cannot serve for that intent, because they reach not the foresaid part, and because they are found likewise in Women.

The transverse Muscles.

The *fifth pare* called the Transverse Muscles, being lowest in situation, do arise from a certain Ligament which springs out of the *Os sacrum*, and covers the *Musculus sacrolumbus*, also from the lowest Rib, and the *Os Ilij*. *They end* by a membranous Tendon, into the white Line, and do stick extream fast to the Peritonæum, every where save about the Share. The proper *Use* of these Muscles, is to compress the Gut Colon.

The Action of the muscles of the Belly.

The Action of all the Muscles of the Belly, is as it were twofold. 1. An equable Retension and Compression of the Parts in the Belly: For they all act together, the Midriff assisting them, and this is the reason why the Fibres of all the Muscles, do meet together in one and the same Centre, according as they are thus described by *Robert Flud* *

Why there are divers muscles of the Belly?

2. The Second Action follows upon the former, viz. the voidance of Excrements. And because the number of parts to be compressed is great, as the Guts, Womb, Bladder; one Muscle could not suffice, but there was need of divers, acting in divers places, according to divers Angels:

A Præoccupation.

Right, transverse, oblique. Every part indeed hath an expulsive Power; but those parts which are hollow, and often, and much burthened, do need the help of these muscles; as in the Expulsion of Excrements, of Worms, of Urin, of a Child, of a Mole, &c.

A Secondary action of the muscles of the Belly.

These are their true Actions, which are apparent from their Fabrick. But Nature sometimes abuses the muscles, to move the Chest, when there is need of a great and violent Expiration, as in Outcries, Coughs, and the like. For then they do not a little compress the Chest.

Their Use. They are of an hot and moist Temperament. because flesh is prevalent in them: And therefore they *cherish Heat and Concoction*: They are moderately thick; and therefore they defend the Parts, and are a Safeguard to them, even when they rest: Also *they conduce to the Comlyness of the Body*: And therefore extream Fat, dropsied Persons, such as are very lean, &c. are deformed.

CHAP. VII.

Touching the Peritonæum.

Peritonæum, how so called?

ALl the Muscles of the Abdomen being removed, the *Peritonæum* comes in sight, being spread over the Guts, and having its Name *a circumtendendo*, from stretching and spreading about, because it is drawn over all those parts, which are between the Midriff and the Thighs.

What it is?

Now the *Peritonæum* is a membrane which doth cloath the Bowels of the lower Belly.

It is a membrane, and that sufficiently *thin* and *soft*, that it may not be burthensom; but *strong* and *compact*, that it may be loosned and distended. *It is thicker in Women, from the Navil to the Share*, that it may stretch the more, when they are with Child; in men that are great Feeders especially, it is thicker from the *Mucronata Cartilago*, to the Navil, *Laurentius* conceives for the Stomachs sake, which notwithstanding is hardly probable: for it was fit the lower part should be thicker, least while we stand, it should become slackned and loosned by the weight of the Bowels.

Some will have the Peritonæum to be made of a ligamentous and nervous Substance; *others* of Nerves only; *others* only of Ligaments; *others* of the Coats of the Brain.

The Shape of the Peritonæum.

The *Shape* of the Peritonæum is oval: For it is like a Bladder, or a long-fashioned Egg. For it compasses all the lower Belly, and therefore it is answerable thereunto in *Longitude* and *Latitude*.

Its Surface.

Its *Surface* is inwardly smooth, and as it were daubed with moisture, by reason of the Guts which it toucheth; without it is fibrous, and a little rough, that it may be fastned with the muscles.

Original.

Its Original is at the Back-bone, at the first and third Vertebraes of the Loins, where the Peritonæum is thicker; so that it cannot in that place be separated without breaking.

Connexion.

It is knit also above most closely to the Diaphragma (and therefore when it is inflamed, the Hypochondria are drawn upwards) beneath to the Share-bone and the *Os Ilij*; before, to the white Line and the Tendons of the transverse muscles.

It is double.

Now it is in al places double (and *Laurentius* with *Cabrolius* make al Membranes double, even the *pia Mater* it self) which notwithstanding is most apparent upon the Back-bone, above the Navil it sticks so close, that its doubleness cannot be discerned: But from the Navil to the Share, it is manifestly divided into two Coats, so distant, that in their capacious doubleing the Bladder is contained, which hath been observed by few: And that was so ordered. 1. That the membrane might be stronger there, where it is burthened. 2. That the umbelical Vessels, which run out there, may be carried more safely: For they pass through the Doublings of the Peritonæum. Therefore also.

The Error of Fernelius.

How many Holes there are?

The Peritonæum is *boared through before* in a Child which is in the Womb: Also *above* it hath holes, where it grows to the Diaphragma, for the passage of the Vessels. *Fernelius* hath therefore done ill to contradict *Galen*, in denying that the Peritonæum hath Holes. They are three; The first where *Vena cava* passes through; The second where the Stomach passes; The third where the great Artery and the Sixt pare of the Nerves do pass through the Midriff. *Beneath* about the Fundament, the Neck of the Bladder and Womb, and the Vessels which pass through the Peritonæum to the Thighs, the Muscles of the Abdomen and the Skin.

Its Productions.

It hath two oblong *Processes* or Productions, like Pipes and wide Channels, descending in men, into the Cod, by the Holes of the Tendons of the oblique and transverse muscles, in which productions (call'd by the Ancients *Didymi*) the Seminary Vessels descend and run back, and near the Stones: These productions are more widened, and become the Coats of the Testicles.

Where-

creeps upwards between them, towards the Orifice: but before it reaches the ſame, it is obliterated; in ſome it is not viſible, becauſe of its ſmalneſs, in ſome it is quite abſent [and therefore peradventure thoſe perſons have no good Concoction, or Nature Recompences that defect with other Arteries] in others I have ſeen it flouriſhing, with manyfold branches. And becauſe it is implanted into the bottom of the ſtomach, and blood emptied there, cannot provoke Appetite, as many imagine. Others will have it that a Melancholick Excrement which could not be changed in the Spleen, is by this Veſſel brought into the ſtomach, that by its harſh and acid faculty, it might further the ſtomachs Concoction, and make the meats abide therein, a convenient ſeaſon. But Concoction ſhould rather be hindred, by the caſting in of a ſtrange Excrementitious Humor. If we ſhall interpret it touching an acid fermenting juyce, the Opinion will be truer, which kind of juyce, can come from no other place but the Spleen. For according to the Obſervation of *Walæus*, the Spleen, eſpecially of a Sow, being boyled and eaten, as coming neareſt that of a man, doth wont to help the heavyneſs and dullneſs of the Stomach. Hence ſharp things are pleaſing to the Spleen, and *Hippocrates* gives Vinegar to Spleenetick perſons, and *Celſus* makes a Cataplaſm for the Spleen tempered with the ſharpeſt Vinegar. Moreover *Riolanus* hath found the left ſide of the inner part of the Stomach blacker then the right. *Others* ſuppoſe that nothing is carried into the ſtomach by the *Vas breve*, but that ſomwhat is carried out of the ſtomach into the Spleen; whether it be the thinner part of the Chyle, as *Conringius*, *Horſtius*, and *Regius* prove, or Blood as *Hogeland* conceives; they being informed by Ligature in diſſections of live Creatures: of which hereafter.

Whether blood caſt out of the Spleen help Appetite and Concoction.

Moreover the ſtomach receives Veins from Vena Portæ, viz. the Pyloric, Gaſtric, and Gaſtroepiploic branches left and right.

There is one notable Vein called *Gaſtrica*, which creeps a long the bottom of the ſtomach, but doth not quite touch it leaſt the ſtomach being very much ſtretched, it ſhould be in danger to be broken; but it ſpreds many branches to the ſtomach: which *Picolhomineus* and *Aquapendent* will have to ſuck out the more thin and ſubtile part of the Chyle, before it paſſes out of the ſtomach to the Liver. And this Opinion ſeems probable. 1. Becauſe otherwiſe no reaſon can be given, of ſo ſudden a paſſage, ſeeing they who have drunk much, do preſently Piſs it out plentifully. 2. Otherwiſe the ſtomach would be ready to burſt, when it is overcharged. 3. Thence it comes, that ſtrength is ſo ſoon repaired by fragrant Wine, broaths, and other comfortable things.

In ſome Men a part of the Choler paſſage, is inſerted into the bottom of the ſtomach, by which our Country-men *Petrus Severinus*, would have choler to be carried into the ſtomach. But this is an Error of Nature, and therefore ſuch perſons are apt to vomit Choler, for they are exceeding Cholerick, ſuch as *Galen*, *Veſalius*, *Fernelius*, and *Caſſerius* have obſerved. Such perſons are ſaid to be *Picrocholoi ano*, vomiters of Choler.

The ſtomach receives *Arteries* from the *Cæliaca Arteria*, which accompany the Veins, not only for lifes ſake, but that blood may be ſupplied from the Heart, for nouriſhment, for that the ſtomach ſhould be nouriſhed with Chyle, is a falſe opinion and now out of date. Seeing it is nouriſhed with blood, after the manner of other parts (it is only delighted with the chyle) which is brought out of the Arteries; which blood flows back again to the Heart, according to the Doctrine of Circulation proved and aſſerted by the renowned *Walæus* in his Epiſtles. By the Splenic Arteries an acid ſharp juyce is conveighed into the ſtomach from the Spleen, as the ſaid *Walæus* and *Hogeland* conceive, which I grant when there is no *Vas breve*, or in abſence of the Spleen, wherein I eaſily conſent with *Riolanus*.

Alſo it hath *Nerves* from the ſixt pair, viz. a couple in its Orifice, from the ſtomach branches, being produced after it hath run back in the Cheſt and furniſhed the Lungs and Pericardium; which becauſe they are ſoft and go a great way, they are covered with ſtrong Membranes. And they do ſo croſs one another, that they are carried obliquely and conſequently with greater ſafety. The right branch compaſſes the fore and left part of the mouth of the ſtomach; the left the hinder and right part thereof. And therefore becauſe the Orifice is ſo compaſſed with Nerves, as if it were altogether compoſed of Nerves: thence it is that this Orifice of the ſtomach is exceeding ſenſible; for there was to be the ſeat of Appetite and hunger: even as thoſe that are very hungry, do feel that part to be as it were contracted and wrinkled together. Alſo branches of Nerves are ſent from theſe downwards to the very bottom. A branch goes from the left Nerve, a long the upper part of the ſtomach to the Pylorus, which it infolds with certain branches, and goes to the hollow of the Liver. Other two Nerves alſo go unto the bottom of the Stomach, from the branches which run along by the Roots of the Ribs. And therefore it is no wonder, that when the Brain is ſmitten and hurt, the Stomach is diſturbed, and falls a vomiting, eſpecially in the pain called *Hemicranea*: As alſo that when the Stomach is miſaffected, the Animal Faculty languiſhes.

Its Nerves.

In the Stomach *Fermentation* of the Meats goes before Concoction, which *Hippocrates* inculcates in his book *de Priſca Medicina*. Becauſe hard things ought to be broken to peices; and thick things as bones and ſhells, &c. in the ſtomachs of Beaſts, ſeem impoſſible to be melted by the natural heat alone, unleſs ſomwhat elſe do cut them in peices. This labor *Petrus Severinus* attributes to Choler, which nevertheleſs according to the ordinary Courſe of Nature is not found in the ſtomach, nor does it diſſolve any hard meat, though Painters uſe to temper their colours. *De la Chambre* attributes it to Spirits, without which it can hardly be performed, *Riolanus* ſuppoſes that it proceeds from the Reliques of the Chyle, which have attained a fermenting faculty; it concurs indeed, for a fermentative quality may be communicated to any thing: but we muſt come to ſome firſt, thing, by which the Chylus is fermented, and from whence the ferment of the firſt meat was derived, before the Reliques of the Chyle could ariſe. The *greater part of Doctors* do attribute this whol work to Melancholy, which is carried by the *Vas breve* into the ſtomach, and of which Melancholick perſons, who are otherwiſe no good digeſters, do often complain by reaſon of its ſharp taſt. Which Melancholy, if it be underſtood of the acid juyce, it may be allowed. For any acid or ſharp things taken in, as Vinegar, and Meats ſteeped therein, Juyce of Citrons, Oyl of Sulphure or Vitriol, Cream of Tartar, and the like, do eaſe and amend the weakneſs of the ſtomach. Alſo without the Body Vinegar ferments the Earth and Milk, even as black-

The Stomachs Fermentation.

choler doth, and the acidity of Vitriol ferments Treacle, and four leven makes the bread arise, &c.

Three things requisite to Concoction,

Now *Johannes Walæus* requires three things to Concoction, first some moisture to temper the meat and make it liquid, viz. Drink and Spittle; in the next place, somwhat to cut and mince it as it were, as the thin sharp humor, and lastly somwhat to melt and make liquid that which is cut, such as is heat, wherewith in ravenous beasts and some Men, the chyle is made fluid, though they do not alwaies drink, I should not doubt, but that the Excrements of the third Concoction, sticking to the Crust, as being still impregnated with the virtue of the parts nourished, do give some assistance to the Concoction, which when they are fretted of, is impared, and so in long fasting men are not so able to digest: And that the spittle besides moistening and tempering the meats, doth perform some other more noble work in Concoction, viz. prepares the meat in the mouth, whereupon it comes to change its smels; and heals Tetters, and either kills or chases away Scorpions and Spiders.

But what becomes of that acid Juyce, when it hath performed its office of fermentation? *H. Regius* beleives that it remaines after the expulsion of the Chylus, to prick the stomach and provoke Appetite. But hunger is raised in the sensible mouth of the stomach, and not in the bottom thereof, where this acid juyce is; also there would be hunger after the stomach is full. I should think that it is expelled with the Chyle, and that then it is either therewith turned into blood, or that in obstructions of the Mesentery, it goes downwards, and raises disturbance.

Concoction is the Stomachs Act.

The Action of the stomach is *Coction* which is termed Chylification. For the stomach is the Organ of the first Concoction, the beginning and preparation of which Concoction is performed in the mouth, the middle in the bottom of the Stomach, and the Conclusion in the smal Guts. Now

How it is made.

this Concoction is performed by heat, not of the stomach only, but also of the Neighbouring parts; as also by a faculty which is naturally bred in the stomach of every Animal. Now it turnes the meats into a white Chylus or Juyce, of a like substance, whiles both its Orifices being shut very well, it contracts it self, and closely embraces the food. But touching the whole manner of Concoction see the forecited Epistles of *Walæus*.

The use of the Stomach.

Its *use* is to receive the Meat and Drink, which it doth by reason of its notable and large Cavity. And whereas it somtimes contains and breeds little stones, as *Gentilis* and *Zacutus* have observed, as also a Toad, Worms, and other things by me often observed; this is beside the Intention of Nature. And the like we may say of an Infant conceived and formed there and voided out at the mouth, the History whereof is described by *Salmuth*.

CHAP. X.

Of the Guts in General.

The Guts. THe Guts are oblong, round, hollow bodies variously wreathed about, joyning with the Pylorus and reaching to the Fundament; serving to receive the Chylus and the Excrements of the first Concoction.

Why called Intestina.

They have their name of *Intestina inwards*, because they are in the inmost seat of the Body [whence *Tirtullian* cal'd the Crosses, the *Intestina Trophæorum*, the inwards of the *Trophies*] and so the Greeks term them *Entera*; some have termed them *Chordaj*, and thence the Barbarians had their term *Chordæ*; for which cause also the strings of musical Instruments because they are made of dried Guts are termed *Chordæ*, Chords.

Their greatness

Their *Magnitude* in respect of the Contents of their Cavities, and the thickness of their substance, is different, as shall be shewn hereafter. The weight of all of them dried, is according to the observation of *Lossius*, a pound. Their length, for the most part doth exceed the length of the person whose they are six times, little more or less. *Picolhomineus* saies they are a foot and half shorter; they are reckoned to be seven times as long by *Laurentius*, *Paræus* and *Riolanus*, and before them by *Celsus*, who nevertheless began to measure from the *Oesophagus*. *Hippocrates* saith they are near upon thirteen cubits, or not less then twelve: but the ful stature of a man, hardly exceeds three Cubits and an half. *Flud* in a certain Body an ell and half long, found the Guts to be but nine ells in length, so that no certain Measure can be determined. It varies according to the Multitude of the windings, and the greedines of the person in point of eating.

The use of the turnings and windings of the Guts.

They have turnings and windings all over save at the beginning and end, that the Ingress and Egress might not be hindred. Now the reason why they have these windings and turnings is.

1. That the nutriment may not slip away, before Concoction be perfectly finished. Also least if it should presently slip away, before the Chylus be distributed, we should be compelled presently to eate more meat, and so should be hindred from our business through greedyness of eating. Hence it is that living Creatures by how much the way is streighter from their stomach to their Vent, by so much the more greedy they are of eating; and the more their Guts are coiled, the more abstinent they are: which *Cabrolius* observed in a very great eater, who had one only Gut, bowed after the manner of a Greek *Sigma*. 3. That we might not be continually going to stool, as it is with greedy Animals, seeing the Excrements may lie long in those windings.

Their Situation.

They are situate in the lowest Belly, the greater Cavity whereof they fill up, somtimes they are forced to the right side, as I have seen in an Hydropick Woman dissected. They are *knit together* by the Mesentery, by which, and the Call coming between, they are tyed unto the Back, and are propped up in the Cavities of the *Os Ilij*.

Their Substance.

They have a membranous *Substance*, like that of the Stomach; so that they may be distended by Chyle, Dung, and Wind. But their Substance is thicker in the thicker Guts: And the nearer they grow to an end, the thicker they are, as the End of the Colon, and the *Intestinum rectum*.

Their Coats.

This Substance of the Guts may be divided into *three Coats*: The first is proper and internal, and is in the smal Guts wrinkled, in the Colon stretched out into little Cells, being otherwise sufficiently nervous. A certain membranous *Crust* as it were compasses about, bred of the Excrements of the third

Their Crust.

The

The Stomach is seen open, and the Bowels beneath the same and Joyned thereto, much in their natural Situation.

The X. TABLE.

The Explication of the FIGURE.

A. *The Oesophagus or Gullet.*
B. *The upper Orifice of the Stomach.*
b b. *The Stomach Nerves embracing this Orifice, rudely expressed.*
C. *Pylorus or the Porter.*
DD. *The common ventricle of the Stomach separated.*
E. *The first proper Coat of the Stomach, being the middlemost.*
F. *The second proper Coat of the stomach, which is inmost and wrinkled.*
G. *A portion of Duodenum.*
h. *The passage for Gall.*
IIII. *The Guts Jejunum and Ileum, with Vessels creeping through the same.*
K. *The blind Gut, or the Worm-fashion'd Appendix.*
LLLLL. *The Gut Colon.*
M. *The Valve in the beginning of the Gut Colon, opened.*
m m m. *The Ligament containing the Cells of the Colon.*
NN. *The streight Gut is here seen, the thin Guts lying thereon being removed.*
O. *The Sphincter Muscle of the Fundament.*
PP. *The Muscles which lift up the Fundament.*

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Concoction of the Guts. 1. That the Mouths of the Mesaraick Veins may not be stopped. 2. That neither they nor the inner Coat might be made hard and callous, by the continual thoroughfare of the Chylus. Also the second is proper, and the middle most, being strong and furnished with fleshy Fibres. The *third* is common and external, being bred immediately of the Membranes of the Mesenterium [save that where the Duodenum and Colon cleave to the Stomach, it arises from the lower Membrane of the Call] but mediately from the Peritonæum. Of these two proper Membranes, the inner is often hurt in a Dysentery or bloody Flux, that other remaining unhurt.

Their Fibres. They have *Fibres*, not only transverse, as is commonly conceived, but of all kinds: The innermost hath oblique ones; the middlemost hath transverse ones. The right Fibres which are allotted for the safeguard of the transverse ones, are fewer in the thin or small Guts, more in the large, especially the right or the last Gut, which was to be strong, because it did collect hard Excrements.

The Guts are covered on the outside with *Fat*, on the inside with a slimy snotty Substance, that the Dung may thereby pass more freely, and that the Guts may be duller in point of feeling.

Their Vessels. For *Vessels* they have the *Venæ Lacteæ* or milkie Veins, which are chiefly distributed between the common and proper Membranes, which carry the Chyle to the Liver; and others from the *Vena Portæ*, which are conceived to bring Blood for Nourishment, but they rather carry back to the Liver the Blood which remains after the Guts have received their Nourishment. They have also Arteries from the Cæliaca for life, which by their motion preserve from putrefaction, but especially to bring Nourishment from the Spleen to the Guts, which wanted such kind of sustenance. They have *Nerves* from the sixt pare of Nerves. But *Walæus* conceives that the Guts have such great plenty of Arteries and Veins. 1. That Excrements might be conveighed to the common shore, which are contained in the Vessels, whence the Child in the Womb, though it take

no

no meat in at the mouth, yet hath it Excrements in the Guts. 2. That greater plenty of Blood might be carried through the *Vena portæ* and the Liver, and might come to be perfected by the Liver.

Difference of the Guts. All the Guts are commonly *divided*, into the *thin*, or *small*, and the *thick*, or large Guts. For though they make one continued Channel from the Pylorus to the Fundament: Yet becauſe this paſſage doth vary, in Magnitude, Number of Turnings, Subſtance, Situation, Figure, and Office, therefore is it diſtinguiſhed into divers Guts.

Whether the thin Guts may be right ſaid to be uppermoſt? The *thin* or ſmall Guts, ſo called by reaſon of the thinneſs of their Membranes, are ſituate partly above, partly beneath the Navil; and therefore they poſſeſs both the Umbilical Region and Hypogaſtrium, which is not ſo in Dogs. Whereupon the *Ancients* taking Example from Dogs, called the upper Guts thin, the lower thick: which is falſe in Mankind. For a Man hath more of the thick Guts above his Navil, and more of the thin Guts beneath; ſeeing that which is the longeſt, is beneath: and the Jejunum which is ſhort is above. And therefore all the ſmall Guts are in the middle Region about the Navil. 1. Becauſe they are the more noble. 2. That they may be the more near to the Centre of the Meſenterie, and conſequently receive Veins and Arteries immediately from the Meſenterie, and quickly conveigh the Blood to the Liver. Now the ſmall Guts are three: Duodenum, Jejunum, and Ileon. And theſe perfect and diſtribute the Chyle: In as much as by reaſon of their narrowneſs, every part of the Chylus may be touched, by their Coat and Veſſels. This Diſtribution is holpen by the inbred Periſtaltick motion, whereby the Guts are contracted from the upper part downwards.

The thick Guts. The *Craſſa Inteſtina* or thick Guts, are ſo called, becauſe they have thicker Coats; they contain the thick part of the Chyle: And are made to collect, and for a ſeaſon retain the Dung. And they are three; Cæcum, Colon, and Rectum. And they are ſituate by the ſides of the ſmall Guts, which they wall about as it were, that they might give way to the thin Guts, and that the thin Guts might not be oppreſſed by the thick.

Their Uſe. The *Uſe* of all the Guts is, to be like the Earth, out of which the Meſaraick Veins ſuck Blood, and the *Venæ Lacteæ* or milkie Veins ſuck Chyle. And the *uſe* of the *thin Guts* is, to concoct the Chylus yet more in the paſſage, and to diſtribute the ſame. Of the *thick Guts* to contain the Excrementitious Reliques of the Chyle, viz. the Dung; alſo Winds and Choler proceeding from the Liver. A *Secundary uſe* of the Guts being dried, is to cure pains of the Cholick, and other Diſeaſes of the Guts; and being preternaturally depraved, to contain ſeveral ſorts of Worms, and Duggs, and Stones; alſo variouſly to be affected, of which Phyſitians are wont to treat.

CHAP. XI.

Of the Guts in Particular.

The Gut Duodenum. THe *firſt* thin Gut, under which the Sweet-bread lies, eſpecially in Dogs, is called DUODENUM. *Galen* terms it *Ecphiſis*, *Horophilus*, *Dodecadactylon*, as if it were juſt twelve fingers long; though in the daies and Bodies of ours, it is not found ſo long; nay it is hardly four fingers long, unleſs men are grown leſs of ſtature then they were anciently, which is not credible. Nor can we underſtand the fingers breath, of which this Gut hardly attains to eight, unleſs peradventure the Ancients did alſo comprehend the Pylorus in ther meſuring.

It *proceeds* in the right ſide, from the Pylorus towards the Back-bone, or under the Stomach, where being joyned to the Vertebra's of the Loins, by membranous Ligaments, it defends right along, without any Circumvolution, and is *terminated*, where the Windings and Wreathings begin.

It is *thicker* then the reſt of the thin Guts; but hath a more narrow Cavity, leaſt the Chylus ſhould ſlip in too faſt. I ſaw a large one at *Padua*, and *Aquapendent* deſcribes ſuch another being puffed with Wind, ſuch as that was, mentioned by *Trafelman*, which had in it many Stones as big as Nutmegs, of an Aſh-color.

The Holes of the ſaid Gut. It hath *two Holes* beneath, towards the Gut Jejunum; the one being the outlet of the Exoler or Gall-carrying paſſage, which is the reaſon we find it yellow in our Diſſections, the other is the new paſſage of the Pancreas or Sweet-bread, invented by *Wirſungus*; which I have notwithſtanding ſometimes ſeen grow together, and joyned with one only Mouth.

Its peculiar *Uſe* aſſigned by *Helmont*, is to change the acid Cream brought out of the Stomach, forthwith into a brackiſh Salt.

It hath a proper *Vein* called *Vena duodena*.

It hath an *Artery* from the right Branch of the Cæliaca.

The Gut Jejunum. The *ſecond* is called JEJUNUM, becauſe for the moſt part it is more empty then the reſt, eſpecially in Diſſections. 1. By reaſon of the plenty and greatneſs of the Meſaraicks [the milkie Veins] which in that place are as it were infinite, and do preſently ſuck out of the greateſt part of the Chyle. 2. By reaſon of the moiſtneſs of the Chyle paſſing through. 3. By reaſon of the nearneſs of the Liver. 4. By reaſon of the Acrimony of Choler. For the cholerick or Gall-paſſage, enters in at the beginning of this Gut, or at the End of the Duodenum, bringing Choler from the Liver to provoke Expulſion.

Its inner Membrane is longer then the Outer, and therefore it is wrinkled into Foles, the better to ſtop the Chyle, ſlipping by.

Rſolanus falſly ſaies that Women have no Jejunum Inteſtinum, being deceived by thoſe, who either were dull-ſighted, or finding this Gut filled, thought it could not be the Jejunum. *Laurentius* obſerves, that it appears ſomwhat reddiſh, by reaſon of the Neighborhood of the Liver.

It hath *Veins* from the *Meſenterica dextra*, which are common to the reſt of the Guts, excepting the laſt, or *rectum Inteſtinum*, the ſtraight Gut.

It hath *Arteries* from the upper Meſenterick Artery.

Nerves from a Branch of the ſixt pare, which is ſpred out unto the Roots of the Ribs.

The Gut Ileon. The third is called Ileon, becauſe it is rouled ſo and twined, it is alſo for that cauſe termed *Volvulus*, by reaſon of many Circumvolutions, which make for the tarriance of the Meat, and for that cauſe it hath fewer pleites or foldings.

It *ariſes* preſently after the Jejunum, where few meſaraick

The Coats and Veſſels of the Guts are explained in this TABLE.

The XI. TABLE.

The FIGURES Explained.

FIG. I. A Portion of the Gut together with the Meſaraick Veſſels.

AA. *A Portion of the Gut, as yet whole.*

BB. *The External Coat of the Gut ſeparated, that the Carriage of the Veſſels under it may be diſcerned.*

CC. *The middle Coat of the Guts, or the firſt proper Coat.*

DEF. *The Meſenterick Veſſels, of which* D *points out the Vein,* E *the Artery,* F *the Nerve.*

FIG. II. Expreſſes the Coats by themſelves.

GG. *The common Coat of the Guts ſeparated.*

H. *The middle Coat of the Guts.*

FIG. III.

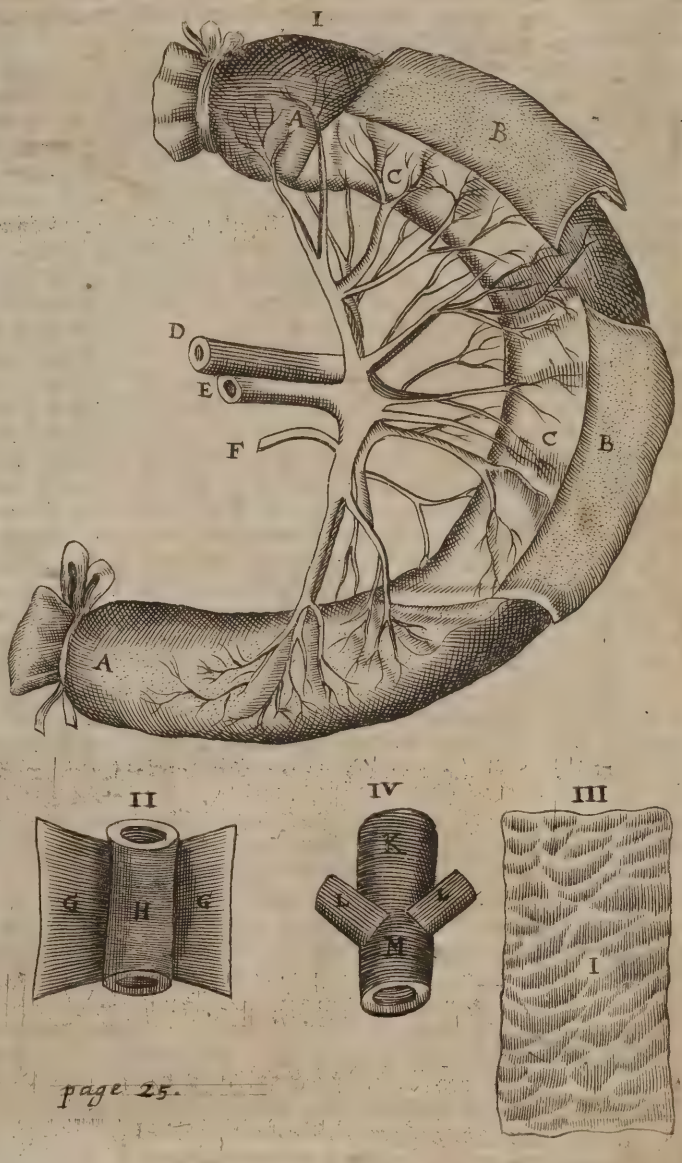
I. *The inmoſt Coat of the Guts with its Plaites elegantly expreſſed.*

FIG. IIII. Preſents the Muſcles of the *Inteſtinum rectum*, or ſtraight Gut.

K. *A Portion of Inteſtinum rectum, or ſtraight Gut, or Arſe-gut.*

LL. *The two Muſcles called* Levatores Ani, *or Lifters up of the Fundament.*

M. *The Sphincter Muſcle of the Arſe.*



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ſaraick Veins are inſerted.

It *ends* at the Cæcum.

It is ſituate under the Navil, at the Flanks and Hips on each ſide.

It is the longeſt Gut, being near upon twenty one hands breadths in length; it is one finger broad. But the Jejunum is not ſo long, viz. about twelve or thirteen Handsbreadth long, and the little fingers in breadth, unleſs it be puffed up with Wind. And as the Ileon is under the Navil, ſo the Jejunum poſſeſſes well near all the ſpace about the Navil, with its very many turnings and windings.

Rupture of the Guts.

The Paſſio Iliaca.

This Ileon may frequently ſlip into the Cod, whence proceeds the *Hernia Inteſtinalis*, or Rupture of the Guts. And in this Gut happens the Volvulus or *Iliaca Paſſio*, in which the Patient commonly vomits Dung.

Riolanus hath obſerved ſomtimes three Appendices in this Gut, reſembling the *Inteſtinum cæcum*

The thick Guts.

The Gut cæcum, or the blind Gut.

The *firſt thick Gut* is called *Cæcum*. 1. Becauſe of the obſcure Uſe it hath in perſons grown up, howbeit in the Infant in the Womb, it is ſaid to receive the Excrements. *Knobloch* indeed ſaith that it hath a double Orifice, ſevered with a membranous Partition, that by one it may receive from the Ileon, and by the other deliver into the Colon; but we have not yet found this in any man, in whom one and the ſame Orifice takes in and gives out. 2. Becauſe it hath only one Hole, whence it is alſo called *Monocolon*. For it is a little Appendix like a long Worm, which ariſing from the beginning of Colon, and the End of Ilium, of a ſubſtance ſufficiently thick, ſpreds it ſelf upon the Colon like a twined worm, and is annexed to the Membrane of the Peritonæum; but by its End, it is joyned to the right Kidneys, the Peritonæum coming between, and is quite free and looſe from the Meſenterie.

It is four fingers *long*, and as broad as ones thumb, but the Cavity thereof is very ſtrait. *Riolanus* did find it exceeding wide, and equal to the Stomach it ſelf, as I alſo have ſeen it. *Sylvius* did in many find it ſolid, without any Hollowneſs, and in ſuch perſons, the Dung

does go immediately from the Ileon into the Colon. And *Massa* suspects that this Appendix is only bred when the Child being from its Birth troubled with a Looseness, the liquid Dung passing speedily by the Cæcum, and not abiding therein, being frustrated of its Office, it grows lean. Howbeit, I have seen it of the same thinness in a Child new born.

The Intestinum cæcum, or blind Gut of the Ancients.

The Ancients by the Cæcum understood that globous and capacious part, at the beginning of the Colon, which *Celsus* and *Rufus Ephesius* intimate. For that it was known to the Ancients, contrary to what *Laurembergius* imagins, I do hence prove, because 1. They dissected Beasts. 2. *Pollux* and *Aristotle* have set it down distinctly. 3. *Galen* hath distinguished it from the Colon, both by Use and Situation, placing the Cæcum on the right Hand, and the Colon on the left.

The Use of the Cæcum is, not to be only for a marke or sign, as *Hofman* imagines, But first to receive Excrements, least they slip down violently into the Colon, and breed pains, and force us to be contiually going to stool. And there some imagine the Dreggs or Excrements proceeding from cherries and cherry-stones, which have been voided forty daies after they were eaten, did lie lurking. The *Conciliator* contends, that the Dung is here separated from all chylous Matter. *Helmont* places the *Fermentum stercoreum* or turdie Leaven, which turns the Excrements of the Chyle into plain Turds, in this place. 2. It may help somewhat towards the Elaboration of the Chyle, either by sucking out of the white Mesaraick Veins some neglected parcels of Chyle, as *Galen* said, or by digesting the inobedient Chylus, which could not be tamed, in the Stomach and small Guts, by reason of the multitude of Food taken in, as *Zerbus* supposes. 3. It may be instead of a Ligament to sustain the Peritonæum, least it fall down. But *Riolanus* observed this very Gut Cæcum in a certain Apothecary rouled to the Groin, and in little Boys into their Cod, in whom it rested upon the *Os sacrum*. *Severinus* suspects that the Reason why Dogs void their Dung with more then ordinary straining, is, because the cæcum is in Dogs very narrow at the beginning, and a little oblique.

The Gut Colon.

The *second thick Gut* is called *Colon*, from the torment which is sometimes therein caused, by colick pains. Some think tis so called from its Hollowness, and because it shapes the Belly. Others derive it from a word signifying to delay, because it gives a stop to the Excrements that are in passage. The Author of a Treatise falsly ascribed to *Galen*, derives it *a colando*, from straining, because it is narrow like a strainner, and involved, that there may be a Gradation of the Excrement, and that it may not descend all at once.

Its Situation and Progress.

Its *Situation* is various, for its beginning which is capacious and round, is in the right Flank, arising from the cæcum at the right Kidney to which it sticks; then it is turned back upwards under the Liver, where it is sometimes knit to the Gall-bladder, and is thereby dyed with a clay-color yellowishness: It passes further, athwart, under the bottom of the Stomach, and on the left hand is joyned to the Spleen, with thin Membranes, and then it is tyed to the left Kidney, where it hath very crooked Turnings, which are apt to detain both Dung and Wind; and from thence it ends straight long, upon the Rectum. Wherefore it doth as it were compass the whole Belly, and sometimes ascends, and otherwhile descends (hence such as do their business, have commonly one Harvest after another distinct), that the Excrements may be the longer detained, and not flow out all on a sudden, and that we may not every foot be sollicited to go to stool. To which intent also serve its Magnitude and Cells. For;

It is commonly eight or nine hands-breath in *length*, and the thickest and widest of all the Guts.

It hath received *Cells*, that any hard Matter, not before sufficiently digested, might be perfectly concocted, and at last through the milkie Mesaraicks, which are carried to the Colon, that said Matter being concocted, might be sent unto the Liver. And that these Cells might not be dissolved, and that being collected into themselves, they might make the Cavities at times, somtimes greater, and somtimes less.

A *Ligament* described by few, or a *certain Band*, as broad as an half finger, is implanted through the middle thereof, on the upper part long-wise, and ariseing from the Cæcum, is termined in the Rectum. Moreover by reason of its largeness, it hath two strong Ligaments, one upwards, another downwards, that it may be tyed to the upper and lower Parts. *Riolanus* nevertheless accounts these two Ligaments to be but one, opposite to the upper Ligament.

According to the Longitude of the Colon, there are extrinsecally observed certain fat Appendices, from the Spleen to the beginning of the *Rectum Intestinum*, as *Riolanus* and *Spigelius* have observed. Whose use is to moisten the Gut, that the Excrements may slide down the more easily.

A Valve in the Gut Colon.

At the beginning of the Colon, a Valve is placed sufficiently thick and membranous, invented by *Bauhinus*, looking upwards, not downwards, as *Laurentius* writes: for the Excrements do ascend and not descend, when they pass out of the Ileon into the Colon, by reason of upper Situation of the Guts. But if the Natural setling of the Excrements be considered, they descend making hast out of the Body: And thus *Bartholinus* and *Sperlingerus* are reconciled. The first Invention of this Valve, seems to be long unto *Salomon Alberts* an Anatomist of *Witteberg*, as appears in an Appendix to three Orations set forth by him, about the End, and from the Observations of *Schenkius*, *Lib.* 3. *Title de Ilio*. Howbeit, besides *Bauhinus Varolus* did also attribute the Invention thereof unto himself, who was a well known Anatomist in the University of *Padua*, in the year 1572. And therefore *Riolanus* conceives the first Invention thereof, ought to be attributed rather to him then *Bauhinus*; But truly, it is in vain that he seeks to bereave him of this commendation, seeing divers Persons may observe one and the same thing, at one or sundry times, without stealing the Invention one from another. For Nature lies open to all diligent Enquires.

How it is found out?

It is found after this manner: Water poured or wind blown into the Gut Ileon, cannot pass through unless violently: But Water doth a little mar the Gut.

Touching its *Figure* or *Shape* and *Number*, Authors do not consent. For omitting such as wholly deny the same; *Bauhinus* determines that it is only one, having the figure of a Nail. *Archangelus* saith, that there are three Valves at the Cæcum, as in the Heart, looking downwards. I have sought it at *Padua* in many Bodies, and at other places, and alwaies found it, but never more then one, and that of an orbicular or circular Shape. *Pavius* to *Hildanus* and afterwards *Falcoburgius*, did not find out a membranous Valve, but rather a Ring or Circle with an hanging brim. But the said Circle is nothing but a Valve, for some Valves are found

This TABLE expreſſes the Meſentery taken out of the Body.

The Explication of the Figure.

A. *The Centre of the Meſentery, and that part of the Back, where it ariſes from the Membranes of the Peritonæum, which knit the great Artery and the Vena Cava in this place, to the Vertebra's.*

BB. *The great Kernel of the Meſentery, which Aſellius terms Pancreas, into which all the milkie Veins are knit together.*

CC. *Glandules or Kernels placed between the Veſſels, which reach as far as to the Guts.*

DD.EEE. *Part of the Meſentery which ties the thin Guts to the Back.*

F.G. *Part of the Meſentery which is faſtned to the Colon, from the right Kidney to the Liver.*

G.H. *The Membrane of the lower Call, which in this place ſupplies the Office of the Meſentery, faſtening that part of the Colon, which is ſtretched out under the bottom of the ſtomach, unto the Back.*

H.I. *Part of the Meſentery, knitting together the Colon, drawn out from the Spleen to the ſtreight Gut.*

I.K. *Part of the Meſentery, faſtning the ſtreight Gut unto the Back.*

L. *The two Membranes of the Meſenterium, drawn aſunder by the Nailes, between which Veſſels are carryed, and the Fat and Kernels are contained.*

M. *The firſt Membrane of the Meſentery.*

N. *The other Membrane of the Meſentery.*

The XIV. TABLE.

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pret the word *Iuteſtinum* in *Cicero*, for ſome midling bowel] but becauſe like a Circle it embraces the Guts round, and gathers them together into the form of a Globe, and cloaths them. Tis called alſo *Meſaræon*: *Gaza* in *Ariſtotle* tranſlates it *Lactes* [in a large ſenſe] thereby underſtanding that which involves and wraps up the *Lactes* that is the Guts, and what ever is contained in them.

Its Diviſion. It is *one*; but others divide it into the Meſaræon or Meſenterium, and the *Meſo-Colon*. The *former* being in the middle of the belly and knitting together the ſmal Guts: the *latter* which knits up the Colon, in the right and left ſide and in the lower part thereof, cleaves to the right Gut.

Its Figure. It *Figure* is very near Circular, and after it hath been narrow in its riſe, in its progreſs, at the Circumference it degenerates into very many foldings, that it might gather in the length of the Guts: for one hands breadth of the Meſentry, doth embrace more then fourteen handsbreadths of the Guts in a narrow ſpace. In the ſides it becomes oblong, eſpecially on the left ſide, where it deſcends to the *Inteſtinum rectum*. Whereupon *Galen* made a threefold Meſentery: a right, left and middle.

Its Magnitude. Its *Magnitude* from the Centre to the Circumference is a ſpan: but its Longitude and Circumference is three ells.

Its Riſe. It *Ariſes* at the firſt and third Vertebra of the Loyns, [which is thought to be the Cauſe of that great conſent which is between the Loyns and the Guts] where Membranous Fibres are produced from the Peritonæum, which turn into ſtrong Membranes,

Its Veſſels. Through which the Meſaraick Veins [both the Blood and the Chyle-bearers] being exceeding ſmal and numerous, and by little and little running together into fewer and greater, are diſſeminated. [But of theſe more largely in the firſt Manual Chap. 3.] And after the ſame manner the *Arteries*: [from the *Caliaca*, that they may carry arterial blood with heat to the Meſentery and Guts for the Nutrition and Fermentation of each of them and in no wiſe to draw chyle in a ſound ſtate of Body, or other things as *Varolius* and *Spigelius* conceit. And that the blood is Circulated even in the Meſentery, by means of theſe Arteries, I ſhall demonſtrate hereafter againſt *Riolanus*.] It receives alſo *Nerves* from thoſe which are carried from the ſixth pair, to the roots of the Ribs, as alſo from the Nerves proceeding from the Vertebra's of the Loyns, that they may give the ſenſe of Feeling to the Meſentery, as is manifeſt in the baſtard colick and other pains; and an obſcure motion in diſtribution of the chyle.

Its Kernels. It hath *Kernels* interpoſed to fil up the ſpaces, and to cheriſh the heat: but one greater then the reſt it hath at its original which *Aſellius* following *Fallopius*, terms Pancreas: different from the other Pancreas ſituate under the Stomach and Duodenum. Out of this he fetches the Original of the milky Veins, with probability enough, becauſe there they grow all into one, and from hence are carryed both downwards and upwards to the Liver. Add hereunto, that it is in color like thoſe Veins; and the

Veins themselves have in this place somwhat proper, viz. that they are interwoven in the whole Body of this Pancreas, with wonderful turnings, twistings, and twinings.

It is surrounded with *Fat* as in the Call, which proceeds from fat blood slipt out of the Vessels, and retained by the density of the Membranes, and so congeled; that it may cherish the Heat of those Parts, and further the preparation of Chyle.

The Use of the Kernels.

The *Use* of these *Kernels* is, 1. To prop up and support sundry Distributions of the Branches of *Vena porta* and *Arteria magna*. Hence it is, that about the Centre of the Mesenterie are the greatest Kernels, because there is the Distribution of the greater and more collected Vessels. Moreover, these Glandules or Kernels, when they are at any time troubled with a scirrhous hard Tumor; there follows a Leanness of the whol Body, because they bear hard, and lie upon the branches of the *Vena portæ*, and of the milkie Vein, so that the Nourishment cannot be freely carried through the said Veins. 2. To moisten the Guts, with the Humors which they suck out of the Parts, and promote Digestion by way of boyling as it were. Which Use *Spigelius* denies, because there are Animals that have not these Glandules, and nevertheless are fat; and others though they have these, are lean. Which may happen without any prejudice to my assertion, because these former Animals have such good Juyce, as needs no purification; the latter have so little nutritive Juyce, that it cannot sufficiently be depurated by these Glandules. And therefore, 3. They serve to suck superfluous Humors out of the Guts, which was *Hippocrates* his Opinion. I add 4. A peculiar Use, viz. to receive that plenty of milkie Veins which passes that way, and to keep some portion of the Chyle, because 1. It is of like use with that greater middle Kernel, and its substance is the same with that which exceeds this only in magnitude, because greater milkie Veins pass that way. 2. I observed that in Fishes, especially in a Lump-fish male and female, besides the great white one, the others did also send forth a white Juyce. 3. This being granted, both Atrophia and other Diseases are better understood, to which Opinion also *Asellius* seems to have enclined. And whereas *Riolanus* makes the Seat and Root of al Kings-evil swellings to be in these Kernels, and saith they never shew themselves on the outside of the Body, except the Mesenterie be first diseased with the same kind of Swellings, is not likely, for 1. Though they may be remote and accidental causes. 2. There is no communion between these kind of Swellings in the Head, and the Kernels of the Mesenterie. 3. Many have the Kings-evil swellings, in whom these Kernels are perfectly sound. 4. All would be subject to such Swellings, because all have these Kernels. 5. Those people dwelling under the *Alpes*, that are so subject to these Swellings, should have their Mesenterie differing from those that are not so troubled. 6. The said Swellings are filled by any kind of Humor proceeding from any Region of the Body.

The Use of the Mesenterie.

The *Use* of the *Mesenterie* is to be the common Band of the Guts, whereby they are knit to the Vertebra's of the Loins.

And of its Membranes.

And the *Use* of its two *Membranes*, is that through them the Vessels may pass safer unto the Guts.

Chap. XIII. *Of the Pancreas, or Sweet-bread.*

The Substance of the Pancreas.

THe Word *Pancreas* signifies *All-flesh*, whereas this part should rather be call'd *All-kernel*, its Substance being wholly glandulous, loose it is and shapeless, three or four fingers long, somtimes six or seven, and more, cloathed with a thin Membrane from the Peritonæum, and in fat Bodies, it seems all made of Fat, which others term dirty fat and moisture; some *Calicreas* the Sweet-bread or White-bread, and Lactes; because of its milkie whiteness and softness.

Its Situation.

Its *Situation* is under the lower part of the Stomach, and the bottom thereof, the Duodenum and *Vena portæ*, as far as the Regions of the Liver and Spleen.

Original.

Now its *Original* is at the first Vertebra of the Loins. In the middle its Parenchyma is white.

Its Vessels.

And it hath for *Veins* the Splenick Branch; for *Arteries* the left Branch of *Arteria Cœliaca*; for *Nerves* those of the sixt pares branches, which go to the Stomach and Duodenum, and it hath also little Kernels.

Besides all which, it hath also another *Passage* which is membranous, and of a peculiar Nature by it self, spread out all along the Pancreas, somtimes in a strait Line, somtimes in a crooked Line, which hath been as yet described by no Anatomist, being first discovered at *Padua*, when I was there, in the year 1642. by *John George Versungus*, a very diligent Anatomist, but killed by cruel Fate; it is remarkeable for its Cavity, and the strength of the Walls thereof. I beleive *Fallopius* did not know it. He mentions indeed small Passages, ending into the Pancreas and Kernels next it; but because this passage is only one, he rather saw through a mist the milkie Veins, dispersed into the Pancreas of the Mesenterie and other Kernels. It is for the most part single, though the same Party had found it double running one by another in parallel Lines: A short one in the ordinary place, and beneath it a larger. The Orifice whereof opens widely into the Gut Duodenum, near the Entrance of the Gal-passage, with which it is somtimes joyned by one and the same Mouth, but more frequently (as I found with the Author) by a different but neighboring Circle. The little Valve situate before the egress thereof, looking outwards, keeps the Probe from entring this new passage, being thrust in by the Duodenum. And therefore in a Living creature, being bound towards the Gut, it swells more and more, but beyond it is presently emptyed, if we beleive *Jacobus Baccius*, which is an Experiment hard to make for before that this passage which lies intangled and encombred can be freed, or bound, the Creature dies. From thence this passage creeps through the whole Body of the Pancreas, spreading out on both sides infinite little Branches, until by narrower but orderly disposed twigs, it goes by little and little straight forward, and is silently *terminated* towards the Spleen. But it goes not into the Spleen, although *Folius* hath assured me, that he hath observed it to go thereinto. Peradventure that was against Nature, nor seems it feasible, because the Branches are first obliterated by an orderly defect, ere they touch the Spleen, and there is no cavity there about, thongh an eminent one towards

the

In this TABLE both the Body of the Pancreas together with the new *Wirsungian Passage*, as also the Vessels drawn there through to the Spleen, are expressed.

The XV. TABLE.

The Explication of the FIGURES.

FIG. I.

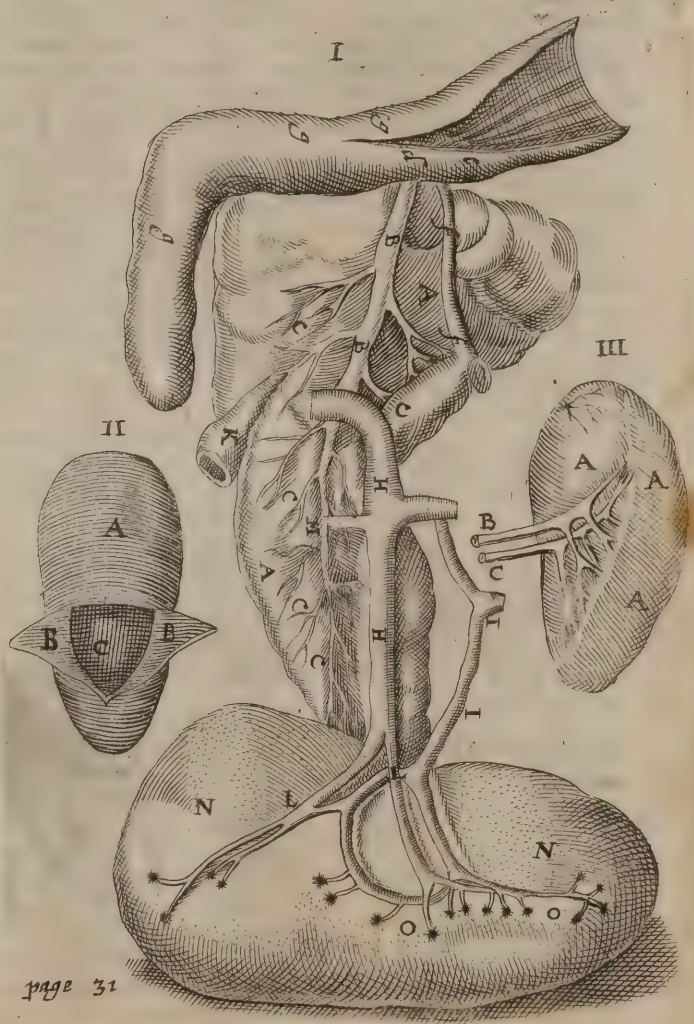
AAA. *The Pancreas dissected.*
BB. *The new Passage found in the Pancreas.*
cccc. *Little Branches of the said Passage.*
d. *The Orifice thereof.*
e. *The Orifice of the Choler-passage.*
ff. *The Choler-passage.*
ggg. *Part of the Gut Duodenum.*
HH. *The Ramus Splenicus.*
II. *The Spleenick Artery.*
K. *A Portion of the Arteria Cœliaca.*
LLL. *Anastomoses or Conjunctions of the Mouths of the Spleenick Vein and Artery.*
M. *The Hemorrhoidal Branch of the Spleenick Vein.*
NN. *The Body of the Spleen.*
OO. *The Ingress of the Vessels in the Spleen.*

FIG. II.

A. *The convex part of the Spleen.*
BB. *The Spleens Membrane separated.*
C. *The flesh of the Spleen, which is blackish.*

FIG. III.

AAA. *The concave part of the Spleen which receives the Vessels.*
B. *The Spleenick Vein.*
C. *The Spleenick Artery.*



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the Guts. In which Cavity (truly) there is no conspicuous Humor, save that a Probe being thrust in, is for the most part died with a yellow cholerick colour, the Walls thereof being coloured with the like tincture, so that Choler seems to be therein contained, by the ordinary Law of Nature, which *Johannes van Horn* likewise a Friend of mine saw at *Venice*, in a cholerick looseness, the said Vessel being evidently full of Gall or Choler. And therefore this new found passages

Its Use. *Use*, is not to carry Chylus out of the Duodenum into the Spleen, because 1. It doth not reach to the Spleen. 2. A Valve hinders the Ingress. Nor doth it serve to carry Melancholy out of the Spleen, to which use serve the *Capsulæ atrabilariæ*, the black Choler boxes. Nor to carry fermentative Juyce unto the Stomach, as *Horstius Junior* ingeniously feignes, Because 1. Such Juyce is not bred in the Pancreas, which is a glandulous Body. 2. The way is more ready to that purpose, from the Spleen; this being a more troublesom and encombred passage, for it would be troubled by meeting the Chylus in the Duodenum, and would be infected by the nearness of the Gall-passage. 3. Never any such Juyce seen in this passage. 4. Who will be bound that it shall be able to pass beyond the Pylorus? Nor is it to prepare Chylus, which *Baccius* affirmes to be found in living Creatures. Nor to nourish the Pancreas, seeing that Humor is therefore unfit, and the cœliack Arteries do that work, but for the common good. But how, or which way shall it return to the Liver? For he rightly denies it to the Spleen. Shall it return to the Duodenum, and from thence to the Mesentery? There would be an infinite Circulation. He shall not easily find it in living Anatomies; also he confounds the Pancreas with the large Kernel of the Mesentery. Nor finally does it send the Excrements of the Chyle to the Duodenum, as *Licetus*, *Riolanus*, and *Vestingus* conceive; for in this Passage no Chyle is seen, but yellow Walls. Moreover the refuse of the Chyle is already voided by stool, nor does the Chyle part with any new Excrement, till it undergo a new change in the Veins of the Liver. Now sure it is, that out of the

Pancreas

Pancreas it self, whose proper passage it is, and in which it begins, and is ended, somwhat is thereby voided into the Guts, and it doth as I conjecture.

1. Purge forth Choler, whether bred in the Digestion of the Pancreas, or in the Spleen, for each of these are taken to be Auxiliary Livers. And it is as it were the Bladder-gall of the Spleen, which is conveniently joyned by its mouth, to the other passage of the Livers-Gall-bladder, by the Duodenum, so that look what use the one affords to the Liver, the same the other may be supposed to afford to the Spleen. And to prevent our doubting, the Humor of Choler daubs the inside of this Passage. To which Opinion of mine, very many Learned men have asserted, though in some things they dissent.

2. To receive into it self the Excrements of Arterial Blood from the Heart and Spleen, though the neighboring Branches of *Arteria Cœliaca.*

3. *Riolanus* counts it a profitable Use, that by this Passage, in vomiting, divers Humors are purged out, and the Redundancies of the first Region; and consequently the fomenting Humors which maintain long-lasting and malignant Feavers and chronical Diseases, and which lurks in the Pancreas, is this way voided forth. And I may well ad somwhat to this most learned Invention. That not only by Vomit, but also by stool, through the assistance of Choler-purgers, hot cholerick Distempers may be by this Passage discharged, which burn the Mesentery, Spleen, Arteries, and Heart it self. And hence proceed cholerick stools in burning Feavers, and blood in a Dysentery or Bloody-flux, by reason of the large Inundation of Choler, continually flowing from hence into the Guts; which is so much the more hard to cure, by how much the Pancreas doth lie out of the reach of Medicaments, being deeply whelmed among the Bowels.

The Use of the Pancreas.

The *Use of the Pancreas it self* is, 1. To prop and support Vessels passing through the same, as the Branches of *Vena porta*, of the Cœliack Artery, and of the Nerves: Especially the *Ramus Splenicus.* 2. To assist the Concoction of the Stomach, which is performed in Heat and Moisture. 3. To serve as a cushion under the Stomach. And therefore that old Woman of *Rome* in whom it was become stoney, fell first into a continual Vomiting, afterwards into an Atrophy or consuming of flesh, and at last died thereof, as *Panarolus* hath it in his Observations. 4. To suck out the wheyish Blood which slides along that way, and through help of the Kernels to purge it. 5. In sickly and melancholick Bodies, to perform the Office of the Spleen, which *Riolanus* shews from the Example of the most renowned *Thuanus*: Whose Pancreas or Sweet-bread, did equal the Liver in amplitude and weight, yet was it wholly scirrhous; but his Liver hard and round as a ball, and full of Flegm like Potters-clay, and his Spleen was found so small, that it hardly weighed an ounce.

CHAP. XIV.
Touching the Liver.

AND so much may suffice to have said touching the Organs destined to primary Digestion or Chylification, we come now to those which are any waies assisting the second Concoction or Sanguification. And the Principal of these is the Liver.

The *Liver* is an Organick Part seated in th eLower Belly, just under the Diaphragma or Midriff, on the right side, being the Organ of Blood-making, and the beginning of the Veins.

Why the Liver is the Original of the Veins?

It hath its Name in Greek, from a Word that signifies want or Indigency, because it supplies the want of the Parts of the Body, the Latins cal it *Jecur*, as if you would say *juxta Cor*, near the Heart. 'Tis called the Principle or Beginning of the Veins, because therein the Roots of two of the greatest Veins appear dispersed, viz. of the *Cava* and *Portæ*, as Roots implanted in the Earth. The milkie Veins are supposed to arise from the Pancreas: Yet Trunks and Branches of them are also to be seen in the Liver. Now the Roots of Trees dispersed in the Earth, do grow together into a Trunk without the Earth. The *Vena arteriosa* of the Heart, is in truth an Artery: And the *Arteria venosa*, is a Vein, and may owe its Original to the Liver, because in a Child in the Womb, it is joyned with the *cava*, and opens it self thereinto by an Anastomosis: And besides, it carries Blood to the Heart, but brings none from it, if there be any force in this Argument.

Its Number.

The *Liver* is commonly but one in *Number*, seldom two: And more seldom is the Liver quite wanting, as in *Matthias Ortelius.*

Its Situation.

It is *situate* in the lowest Belly, under the *Septum transversum* (which also *Hippocrates* and *Aristotle* acknowledged) by the Ribs, and for the greater part in the right Hypochondrium, a fingers breadth distant there from, that the motion thereof might not be hindered: Therefore a Swelling in the Liver causes shortness of breath. In Birds it lies equally on both sides: As also for the most part in Dogs which have a thin and long Spleen. In Man it seldom changes its place, so as the Liver should be in the left, the Spleen in the right side, which *Gemma* and *Spererius* have observed. It rests lightly upon the former and upper part of the Stomach, especially on the right side, for otherwise some part thereof reaches to the left side also, and somtimes the greatest part, the Spleen being very small. But some conceive that *Aristotle* was ignorant of the Situation of the Liver, because the said *Huper de'to Diazoma*, &c. which they interpret, aboye the Septum is the Liver seated. But the Philosoper is thus to be translated: It is placed on the other side, or beyond the *Septum transversum*; for *Huper* with an Accusative signifies beyond, but with a Genetive, it signifies above.

Its Figure.

And by reason of the Midriff, to which it was to give way, it hath its upper and outward *Figure* sufficiently round, convex or gibbous, even and smooth, where also there is an oblong Cavity, behind at the Passage of *Vena cava.* And because of the Stomach it hath received a Figure which is hollow on the inner and lower side, which is termed its simous or saddle side, and it is more uneven then the other having in it two hollownesses: One on the right hand for the Gall-bladder; another on the left, for the Stomach to pass by. So that the Liver is on the right side of an ample roundness, but on the left it is narrow and sharp.

Its Division.

The Liver is *divided* by some, into the right and left part: between which there is a smal cleft or chink, where the Umbilical Vein enters. Otherwise for the most part, it is entire in a Man and undivided, save that *Spigelius* observed here a certain

A Mans Liver is not divided into Laps or Scollops.

The Explication of the FIGURES.

FIG. I. Expreſſes the Liver taken out of the Body, and eſpecially the hollow ſide thereof. The XVI. TABLE.

AAA. *The Liver in its hollow ſide, cloathed with its Coat and ragged Nap.*
B. *The Vena Portæ, and its Egreſs out of the hollow ſide of the Liver.*
CC. *Two Trunks of Vena Cava, by the tuberant or boſſie part of the Liver.*
D. *The going forth of the Navil-Vein from out the Liver.*
EE. *The Gall-bladder ſeated in the hollow part of the Liver.*
F. *The Gall-paſſage, called Cyſticus Felleus.*
G. *The other Gall-paſſage called Hepaticus.*
H. *An Artery which comes from the Ramus Cæliacus to the hollow part of the Liver.*
I. *A branch of this Artery, which enters the Liver.*
KK. *Another branch of the ſame Artery which goes unto the Gall-bladder.*
L. *A Nerve of the ſixt pair which goes unto the Liver.*
M. *A ſmal Lap or Scollup ſtretched out unto the Call, by which the Liver being full of water, is ſomtimes emptied.*
NN. *Certain Eminencies of the Liver, anciently termed Portæ the Gates.*
a. *The bottom of the Gall-bladder, hanging without the Liver.*
d. *The common Channel, made up by the paſſages of Ramus Hepaticus.*

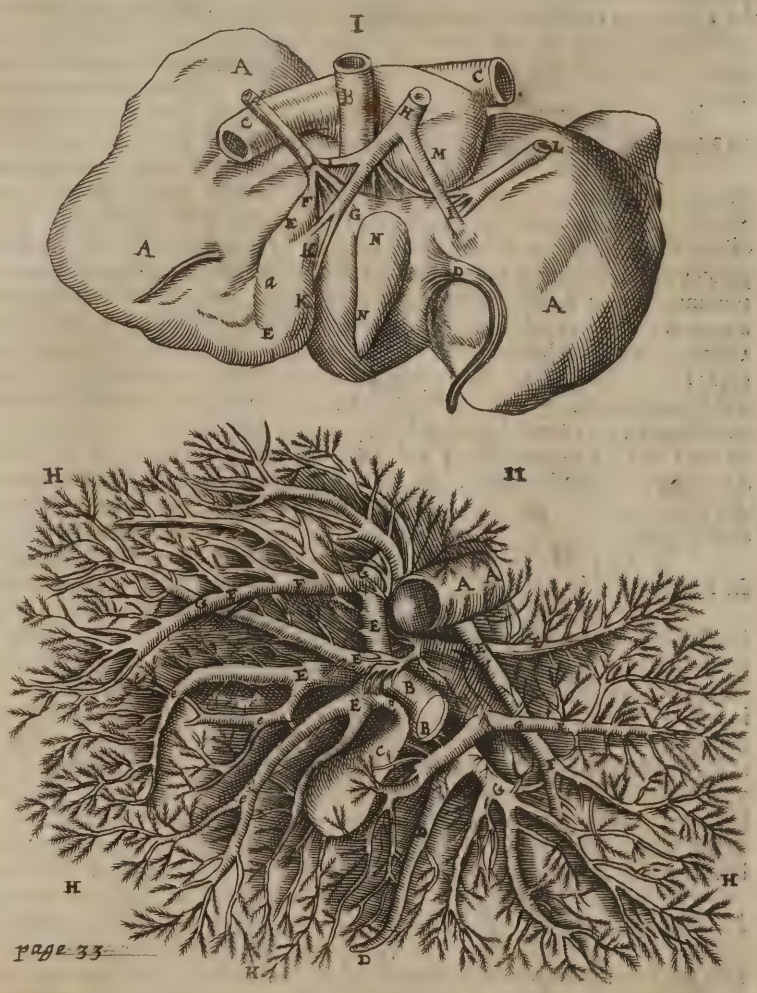

FIG. II. Shews the Veſſels of the Liver freed from the *Parenchyma* or Fleſhy ſubſtance thereof, with the Gall-bladder.

AA. *A portion of Vena Cava.*
BB. *A portion of the Trunk of Vena Porta, paſſing forth of the Liver.*
CC. *The Gall-bladder.*
DD. *The Navil-Vein ending into a branch of Vena Porta.*
EEEEEEE. *The branches of Vena Porta, diſperſed through the whole* Parenchyma *of the Liver.*
FFFF. *The branches of Vena Cava, eſpecially thoſe which are diſtributed through the upper parts of the Liver, and joyned in ſundry places with the branches of Porta.*
GGGG. *The moſt remarkable Anaſtomoſes or joyning together of the Mouths of Vena Cava and Porta.*
HHHH. *The extremities of the ſaid Veins, called* Capillary *Veins, becauſe of their ſmalneſs.*
a. *The* Meatus Cyſticus *or paſſage into the Gall-bladder.*

a certain little lobe, of ſofter Fleſh then the reſt of the Liver, compaſſed with a thin and ſubtile Membrane, which is carried out into the Call, and ſomtimes empties the Liver when it is full of Blood. In this little and ſoft lobe, I have manifeſtly obſerved certain milky Veins inſerted in the cutting up of Fiſhes; ſo that according to the diverſity of the parts of the Liver, we have now the Inſertion of three Veſſels, which hath hitherto been unobſerved. But in Bruits (excepting an Ox and ſome others) it is divided into divers parts,

which they call *Lobes* or Scollops, wherewith they say the Stomach is covered and contained, as with so many fingers. *Galen* therefore and *Plempius* have done ill to say that Mans Liver is divided Naturally into Lobes, Laps, and Scollops, for preternaturally and rarely it is indeed so divided, as *Fernelius*, *Sylvius*, and *Gemma* have observed. *Galen* is to be excused, because he took the Extuberances of the Liver made of the Trunks of the Vessels for Lobes. And *Horstius junior* doth learnedly refute *Plempius*, for giving out the Clefts, Cavities, and Extuberances of the Liver, for Lobes perfectly distinct.

Its Magnitude. The *Greatness* and thickness thereof, is remarkable and exceeding great in a man (as is his Brain) not only for Nutrition as in brutes, but for the breeding of Animal Spirits, which are often dissipated (and they are bred of the Vital Spirit, as it is bred of Blood. Yet it is greater then ordinary in bodies that are of a cold Complexion, and in fearful Persons and great Eaters, to augment the Heat of the Heart. In persons dead of a Consumption, I have somtimes seen an exceeding great Liver, four or five times bigger then ordinary, and somtimes again very exceeding little. And others have found a very small Liver, and somtimes no Liver, or the Liver consumed away; and a great and strong Spleen performing its Office. *Rhasis* and *Abensina* gather the greatness of the Liver from the length of a bodies fingers.

Its Membrane. It is compassed with a thin Membrane, springing from one of the Membranes of the Veins, which hath its Original from the Peritonæum. In this there arise little bladders of water, from whence the Dropsie come, Witness *Platerus*. I have seen of these bladders in a she Goat, many in number, whitish, which being cut open, were found to contain within a single coat or skin, whevish Humor, with snotty Flegm, and another yellow substance, whether through a fault in Nature, or because the Goat was tamed. I have more then once found intertwisted ropes of Worms, in other Membranes of the Liver.

Its Connexion. It is *fastned* by three strong Ligaments. 1. To the *Belly*, by the *umbelicalis Vena*, or Navil-vein, which after the Birth, is in grown Persons dried up, and turns to a Ligament, least the Midriff should dangle too much, and should hang too low down. 2. *Above* to the Midriff, on the right side, by a broad membranous and thin Ligament, but yet a strong one arising from the Peritonæum, which the Midriff undercircles; and this is called the *Ligamentum suspensorium* or hanging Ligament. 3. Also *above* to the Diaphragma, but on the left hand, by another Ligament sprung from the Peritonæum, round, and exceeding strong: Also in its *after-part* where the *Vena cava* passes, it cleavs by its bunchy side to the Peritonæum. *Riolanus* reckons these three Ligaments for one, because he contends that the umbelical Vein is dried up, which being carried through a duplicature or folding of the Peritonæum, hath for its Companion the Membrane it self, which being rouled back over the Liver, runs out upwards & downwards to the Diaphragma it self, which it invests and fastens. But it is al one case. For Ligaments are termed sundry, because they fasten and suspend divers parts of the Liver, although the two latter arise from the Peritonæum. Now therefore according to his reckoning, there will be two Ligaments, not one only; the former from the Umbelical, and the other from the Peritonæum. The fourth Ligament annexed to the *mucronata Cartilago*, at the Cleft of the Liver, is no pecular one, but must be reckoned as part of our second Ligament.

Its Substance. It hath a *Substance* red and soft [so that with a little stick it may be beaten off, and separared from the Vessels interwoven, either when it is boyled or being raw] spred about the Vessels, like congealed blood, for which cause it is termed *Parenchyma*, that is to say an Effusion or shedding forth of blood, because it is poured about the Vessels, and fills the spaces between them [in some kind of fishes it seems to be a congealed Fat, out of which an Oyl is boyled to burn in Lamps. Yet is it hardly corrupted; for *Riolanus* hath observed that a Liver having been accidentally kept a year together, hath remained uncorrupt. In substance it is most like an Oxes Liver, and being boyled, differs not there-from, neither in consistence, color, nor tast; and therefore our flesh is more like that of Oxen then of Swine.

Its Color. The *Color* of a sound Liver is ruddie [but if it be quite void of blood, or boyled, we may rightly say with *Gordonius*, that it is whiteish, as in an Embryo, before affusion of blood be made. But we shall find it very large and red, in Children new born, of a good Constitution. I have demonstrated it to be yellow, in the fish called a Lump. In a Lamprey it is green (which makes *Bronzerus* dispute touching the Principallity of the Liver) though the blood be red, whether it have contracted its color here, or in the Heart, or from it self] In some sick persons, as those which have the Dropsie, it is very pale, as also the Spleen and Kidneys.

Its Vessels. Now those *Vessels* in the Liver, are the *Roots of Vena portæ and cava*, (with a few [to a mans first thinking, but upon serious Examination according to the Observation of *Walæus*, an innumerable company of] small Arteries interposed, of a whiter color, dispersed from the Cœliaca, through the saddle part thereof) [partly that they might nourish the Liver, and warm it throughly with the heat of the heart the branches of *Vena portæ* assisting likewise to the same intent; partly that by the motion of the Pulse, and the necessity of running back, it may assist and provoke the passage of the blood out of the Liver according to the conjecture of *Slegelius*. For whereas *Galen* tells us that the Liver is cooled by the Arteries, that is not consonant to truth: For they are hot, and by their motion further the blood, and draw it to those parts wherein they are implanted;] which appear distinct, the flesh or Parenchyma of the Liver being taken away, how they are carried this way and that way, without order, among which also small branches are dissominated, which afterwards unite into one common Passage, and so carry Choler into the Gall-bladder. Now it is conjoyned with the Roots of *Porta*, that there the Blood may be separated from the Choler. But more Roots of the *Porta* are spred up and down here and there through the lower part of the Liver, very few through the upper part: Contrariwise, more of the Roots of the *Cava* are carried through the upper and tuberous, or bossie part thereof, and fewer through the hollow or saddle part. To these must be added the Roots of the Milkie Veins. *Asellius* did somtimes observe their trunk to be in the Liver. But he did not precisely add the place, which I have determined to be in the third Lobe.

Their Anastomoses. The *Anastomoses* or Conjunctions of the Roots of *Vena Porta* and *Vena Cava*, are peculiarly to be observed. For rejecting those who altogether deny the Union of these Veins,

Veins, or who conceive that they are obſcurely and hardly known: [among whom *Harvey* and *Riolanus* are lately come upon the ſtage, the former of whom could no where find any Anaſtomoſis, either in the Liver, Spleen, or any other Bowel, though they had been boyled, till the whole *Parenchyma* would crumble in peices, and was ſeparated like duſt from all the ſtrings of the Veſſels, with a needle. Only he obſerved this one thing, in a freſh Liver, viz. that all the branches of Vena Cava creeping along the boſſie part of the Liver, have Coats like ſeives full of infinite little holes, as being made for the draught of the Body, to receive ſuch Blood as ſettles there: but that the branches of the Vena Portæ are not ſo but are divided into boughes, and that every where the branches of both, do run out to the higheſt Eminency of the boſſie ſide of the Bowel, without Anaſtomoſes. But the Porta hath likewiſe very many holes great and little, as the Cava hath, ſome of which will admit the probe, others not, only they make certain Cavities covered with a thin Membrane. Whence it is apparent, that the blood is ſtaied by thoſe cloſed holes and not ſtrained out, ſome of them being covered with a Coat, *Riolanus* inſpired by the ſame Spirit, doth ſtrongly oppoſe the Anaſtomoſes of the Vena Cava and Portæ leaſt he ſhould be forced to admit the Circulation of the Blood in that Place. He was afraid that the concocted liquor ſhould be confounded and mixt with the unconcocted. And what if they be, confounded and jumbled together? The Chymus being changed into imperfect blood is confounded coming out of the milky Veins, with that which is contained in the Cava, for both of them are to be perfected in the Heart. And the other which flows out of Porta, prepares both with its acid juyce. But be it how it will be, the Authority of all Anatomiſts doth aſſert thoſe Anaſtomoſes from the times of *Eraſiſtratus* and *Galen* to our daies, becauſe it is manifeſt to ſuch as ſearch diligently, that theſe roots are joyned together, ſomtimes athwart, ſo that one lies over the middle of another as it were, ſomtimes the extremities of one Vein touch the Extremities or ends of another, otherwhiles the ends of one touch the middle of the other; and ſomtimes they touch not one another at all; peradventure where the Branches of the Liver ſerve only for Nutrition. *Baubinus* wiſhes us chiefly to obſerve a remarkable Anaſtomoſis, which reſembles a channel, and is as it were a common and continued paſſage, out of the Roots of Porta into the Roots of Cava, admitting a pretty big Probe. But becauſe we cannot rely upon naked Authorities, experience muſt be called by us to counſel, which doth neceſſarily perſwade us that there are ſuch Anaſtomoſes or Unions of the Mouths of the Veſſels, by reaſon of the paſſage of the Blood out of the milky Veins and the Venæ Portæ, unto the Cava, and out of the manifeſt Arteries, ſeeing the paſſage only through the fleſh cannot ſuffice, in a quick and plentiful Flux. I confeſs all the kinds of Anaſtomoſes are not appearent to the Eye as to be ſeen open, in dead bodies, though no man can therefore deny that there are ſuch things; but ſome of them are inſenſible, which admit neither Probe nor Wind, and ſome admit Wind and nothing elſe. The Renowned *Walæus* obſerved and found by experience, that the Veins of the Porta are in the Liver no where opened into the greater branch of Vena Cava, but that the very ſmalleſt branches of Vena Porta, do open into the ſmalleſt branches of the Vena Cava, as he obſerved in a Liver blown up with wind, after the fleſh was taken away, and floating upon water. I have in an Oxes Liver curiouſly ſought for apparent Anaſtomoſes, becauſe there they muſt needs be viſible becauſe of the greatneſs, following the example of the moſt learned *Slegelius*. But the very truth is they are not viſible to the Eye: the Veſſels indeed are divers waies interwoven and twiſted one among another; Trunk with Trunk, branches of the Trunkes, either with the Trunk of another Vein, or with little branches; and that either in the middle of thoſe little branches, or in the extremities, even as we ſee both the Veſſels cleave together in the Womb-cake: But a Probe finds no entrance, by any open hole of an Anaſtomoſis. Nevertheleſs, it is not to be denied, but that in living Bodies there is a paſſage known to Nature though unknown to us by reaſon of the neceſſity of a through paſſage. Which I the rather believe, becauſe that in the conjunction of the Veſſels, yea even of the greater, where the Anaſtomoſes ſeems ſhut, the Coat is extraordinary thin and for the moſt part ſingle, as appears by its tranſparency, which in Living Bodies being rarified by heat and motion, doth eaſily ſuffer the blood to paſs through.

By theſe Unions therefore of the Roots of the Vena Cava and the Vena Portæ, the Blood may paſs through: And by them likewiſe the peccant matter paſſes, when we Evacuate the habit of the Body by Purgations. Not that it ſhould be carried out of the Porta to the Meſentery, as hath been hitherto beleived, but ſo as thence to paſs through the Heart, and be emptied out through the Cæliacal Arteries, and thence through the ſtomach or the Gall-Conduits into the Guts, forced along by virtue of the purging Medicament.

Thoſe Anaſtomoſes are likewiſe to be obſerved, by which the ſmal Veins of the Gall-bladder, are joyned to the Branches of Vena Portæ and Vena Cava.

The Original of the Veins.

The Roots of Vena Portæ, do by little and little towards the lower part become ſmaller and greater, until they make one Trunk, which is called *Vena Porta*, the Gate-Vein: So alſo the Roots of the Cava, above and in the fore-part do altogether make up one *Trunk*; before the going out whereof, certain Circles are placed, here and there in the greater branches, being of a Membranous ſubſtance and very like to Valves, ſomtimes thicker, other whiles thinner and like Cobwebs, which were firſt diſcovered by *Stephanus*. and after by *Conringius* in an Oxes Liver; and I likewiſe found them, looking towards the larger trunk, which hinder the return of blood, not ſo much of that which is impure and dreggy, as of the pair being once gone out to the Heart: afterwards, as ſoon as it comes to the Liver, it is divided into two great branches, the aſcendent and deſcendent; and hence it is that they ſay, the Cava ariſes from the upper or boſſie part of the Liver, and the Vena Portæ from the lower and hollow part.

The Liver hath two *Nerves* from the ſixt pair, one from the Stomach, another from the Coſtal, diſperſed only through its Coat, and not through its ſubſtance (as *Veſalius* will have it) that in its inmoſt body, it may be void of ſenſe, in regard of ſo many motions of humors. And therefore the pains in this part are dul and rather a kind of Heavyneſs then pain. Yet *Riolanus* hath obſerved, that two remarkable little Nerves do accompany the Vena Portæ, and go into the very ſubſtance of the Liver.

The place of Blood-making, the Matter and Efficient.

The Action of the Liver is Sanguification. For of the Chylus drawn by the Meſaraick milky veins, the Liver makes Blood; and the Blood is made in

The Explication of the FIGURE.

This TABLE shews both sides of the Liver and the Gall-bladder, Distinct one from another. The XVII. TABLE.

FIG. I.

AA. *The Convexe or Bossie side of the Liver.*
B. *The Livers Membrane Separated.*
CC. *The Ligament of the Liver called* Septale.
DD. *The coming forth of Vena Cava, out of the upper part of the Liver.*

FIG. II.

AA. *The concave part of the Liver turned up.*
B. *A Lobe or Scollup of the Liver to which the Call joynes.*
C. *A cleft of the Liver, out of which the Navil-Vein D. descends.*
E. *The Gall-bladder.*
F. *The Gall-bladder Channel.*
GG. *The Choler-passage, ending into the Duodenum* H.
I. *The trunk of Vena Portæ descending from the Liver.*
K. *The Right-hand Cœliacal Artery.*
L. *A Nerve brought unto the Liver.*

FIG. III.

A. *The bottom of the Gall-bladder.*
B. *A Cavity at the rise of the Neck of the Gall-bladder.*
C. *The Neck of the Gall-bladder.*
DD. *The Passage of the Gall-bladder between the roots of the Vena Portæ* F. *and of the Cavæ* G. *dispersed through the substance of the Liver.*
E. *The concourse of the passages of the Gall-bladder.*
H. *The Porus Biliarius or Choler-pipe, broader then the Neck of the Gall-bladder.*
I. *The common passage of the Choler-pipe and Neck of the Gall-bladder.*
K. *The Orifice of the Choler-passage, in the Gut Duodenum.*
L.M. *The Gut Duodenum opened.*
N. *An Artery dispersed into the Liver.*
O. *A small Nerve of the Liver and of the Heart of the Gall-bladder: which the graver hath represented too large.*

in the branches of the milkie veins; the substance of the Liver, doth not only sustaine the Veins, as some would have it, but it is the efficient of Sanguification: And together with Blood, it generates natural Spirit.

The Authors opinion how the blood is made.

Sanguification therefore or Blood-making, is thus performed: the more unprofitable and thicker part of the Chyle (which is made first in the Stomach and finally perfected in the thin Guts) is thrown out into the thick Guts, and voided at the Fundament; but the more laudable and thin part, is drawn in by the milky veins, spred up and down in the Guts; and a little altered, and from them by means of a power proceeding from the Liver, it receives the first Rudiments of Blood, and is then called *Chymus*. The greatest question is whether the Liver draws it, or it is forced thither. It seems to be drawn by the heat of the Liver, as Chaf or Straw is drawn by heated Amber, and as Blood is drawn into the outward parts by hot Fomentations. Which is here visible by Ligatures and live dissections, in which the attraction of the Liver is so great, that the milky Veins are speedily emptied. There is not the same necessity, that it should be forced thither, as others have thought, because the beginning of the Motion or moving principle should either be without the Chylus, or within it. It cannot be in it. 1. Because nothing thrusts or drives, but that which is alive. 2. The Chyle newly drawn out of the Vessels, doth not move it self. 3. It is void of Appetite. 4. It should alwaies be driven downwards, not up to the Liver. Nor can it be in

any

any thing without it. 1. Becauſe the Meſeraick Arteries have enough to do to drive out their own blood, and the Veins have work enough to receive it. 2. And the milky Veins are exceeding ſmall. 3. The proper Fibres of the Veins, do ſerve more for ſtrength, then for driving. 4. The Stomach indeed, and the Guts are contracted, but they are not able to expel the chyle; for their motion is obſcure, and though it were evident, yet it would not preſently follow, that it muſt drive into the Liver. 5. Thoſe Bowels being contracted on all ſides, and ſhut up, as much Chyle is retained, as is expelled. 6. The Abdomen doth oftimes reſt, according to our deſire and pleaſure, being apt to be moved by the Muſcles; but the motion of the Chylus is performed continually and ſwiftly, viz. the due time of diſtribution being come. 7. The dreggy Chyle ſhould be ſent unto the Liver, without difference, as well as the pure. It is therefore *principally* drawn by the Liver, howbeit ſome conſtruction of the Guts, is *ſecondarily* aſſiſtant thereunto. This Chymus being attracted in the Roots of the milky veins, as in the place where, is by the Parenchyma or Subſtance of the Liver, as the Efficient cauſe, with the aſſiſtance of the internal heat of the Chyle, changed into a new ſubſtance of blood. Now it gains a *Redneſs* like the ſubſtance of the Liver, not ſo much from the fleſh of the Liver alone, which it ſelf ows its color to blood ſhed about it, which it layes away when it is waſhed or boyled, and in ſome other Creatures we find it of a green color, as from its own proper and adventitious Heat (as Grapes are red) which vaniſhing away, the redneſs ceaſes, as it happens in blood-letting. Nor is that a ſufficient cauſe, ſeeing in healthy bodies it continues afterwards red, and therefore we muſt take in light as another Cauſe, of which there is a great quantity in red colors, ſubſiſting even without Heat, unleſs the ſubject happening to be diſſolved, it come to be extinguiſhed and exhale. Hence it is, that boyled blood becomes black, and putrid blood is duskie. Hence alſo, by how much the more Natural inbred light any man hath, the more he ſhines with bright blood; contrariwiſe, in Melancholick perſons, the ſame being darkned, the blood grows black and dark. That light and fire are the cauſe hereof appears in Oyl of Sulphur, by the mixture whereof Liquors become red.

Now this *Heat* and *Light*, is partly planted in the liver, and the Chyle it ſelf, ſpringing thereout, by reaſon of its previous preparation, and partly kindled therein, either by reaſon of the nearneſs of the Heart, and bordering parts, or by reaſon of the Arterial blood, derived from the Heart and Spleen.

The more crude Blood being thus made, is not diſtributed to nouriſh the Liver or the Body, which Office is performed by the Heparick Arteries, but by inſenſible Anaſtomoſes of the fleſh and Veſſels, it is expelled into the Roots of *Vena cava*, where by longer tarriance, it is more elaborated, and ſoon after with the returning blood of the *Vena porta* and the Arteries, it is poured out into the Trunk of *cava*, going all ſtraight along, through the upper part of the Trunk to the heart, that it may there attain its laſt accompliſhment, whereby it becomes fit to nouriſh all the Parts. Not any thing returns this way to the Liver, the Valves hindering, which in the Liver look outwards, in the Heart inwards, as the whole Fabrick and Ligatures do teſtifie. By theſe it is, that the *Cava* alwayes ſwells towards the Liver, and is empty towards the Heart.

Afterwards the Nouriſhment of all the Parts of the Body being accompliſhed by the Capillary Arteries, becauſe all the blood is not conſumed, which by continual Pulſations is ſent forth, nor can that which is ſuperfluous return the ſame way, by reaſon of the Valves of the Heart ſeated by the Aorta, which lets any thing paſs from the Heart, but admits nothing back again; and becauſe any Artery being tied, is full, and ſwels towards the Heart, but is empty, and lank towards the Veins: Therefore it muſt needs return as it were by a circular motion, out of the ſmalleſt Veſſels back again into the greateſt Veins, and the Trunk it ſelf of the *Cava*, and thence into the Heart. As it paſſes through the Liver, other blood there newly bred, is joyned with that of the *Vena porta*, and that which is redundant from the Arteries, for the reſtoring of that which is ſpent, and ſo the *Circulation* is again repeated. Mean while, as hath been ſaid, Choler is drawn out of the blood, by branches of veſſels, terminating into the Gall-bladder and Choler-paſſage. But the wheyiſh part, is becauſe of its thinneſs retained a while, that the blood may more eaſily paſs every where, and afterwards it is ſent away, partly to the Kidneys (with the wheyiſh blood, which according to *Galen* is not concocted in the Kidneys, but becauſe the Serum is an Excrement of the Liver, the Kidneys do only ſeparate the blood from the whey) and from thence by the Ureters into the Bladder; whence the Urin does afterward partly go into the Skin, and paſſes out by ſweat and inſenſible Tranſpiration.

CHAP. XV.

Of the Receptacles of Choler, viz. the Gall-bladder, *and* Choler-paſſage.

ON the right hand and hollow part of the Liver, for the Reception of two ſorts of Choler, thick and thin, two Conduits or Paſſages are engraven: The *Veſica biliaria* or Choler-bladder, and the *Canalis biliarius* or Choler-channel. *Galen* himſelf knew as much, when he ſaid that from the Liver a twofold cholerick Excrement was purged; the one unmixt and ſimple, the other mixed and thick, which I collect contrary to what *Hofman* aſſerts, out of the fourth Book of the Uſe of the Parts, 12. and 13. and from the fifth Book Chap. the 6. For the Channel poures out thick and dreggy choler, but the Bladder ſuch as is more thin and yellow. For the latter bordering upon the *Vena porta*, ſucks more plentifully out of the Spirituous and Arterial Blood; the former being placed at the Roots of the *Cava*, draws a leſs quantity of Choler, and ſuch as is more thick, becauſe *that* blood is thicker. *See* Fig. III. Table 17.

The *Veſica biliaria* or *Gall-bladder* called alſo *folliculus Fellis*, is a Veſſel long and round, faſhioned like a Pear, hollow, furniſhed with a double Membrane, the one, whereby it is faſtned to the Liver, from the Peritonæum [which is alſo the ſame, wherewith the Liver is covered] without Fibres, and wherewith that part only is covered, which hangs without the Liver: The other proper and more thick, but ſtrong, having all manner of Fibres; which a certain Cruſt encompaſſes, bred of the Excrements of its third Digeſtion, to keep off the ſharpneſs of the Gall. *The Shape of the Gal-bladder.*

This *Gall-bladder* is *ſmall*, compared to the Spleen and Kidneys. Being two *Its Greatneſs.*

fingers breadths in deepneſs: but the more cholerick any perſon is, the greater is this Gall-bladder obſerved to be.

Diviſion. 'Tis *divided* into the Bottom and the Neck.

Bottom. The *Bottom* is round, and ſeated lowermoſt, viz. when the Liver is in its Naturall Situation, it is died with a yellow color, and ſometimes black, viz. when the Choler being over long kept, is burned.

Neck. The Neck, being harder then the bottom, looks upward, grows long and nartow, until it end into a very ſmall and narrow paſſage. At the Neck is obſerved, firſt a certain peculiar hollowneſs, and alſo certain little Valves or Membranes, ſomtimes two, otherwhiles three, which hinder the Regreſs of Choler. *Regius* proves, that they are ſometimes opened by Spirits, through a Nerve inſerted into the liver, and ſo let Choler return into the Liver; which appears by anger, and the ſudden boyling of the blood in angry perſons, by admixtion of burnt Choler. Howbeit by preſſing, or ſqueezing, and blowing, we cannot force any Choler back. And if the force of the Spirits were ſo great, they might as eaſily open and ſhut the valves of the Heart, when they are in the Arteries more plentiful then ordinary. They pierce indeed by their fineneſs the valves, when they are ſhut, but they carry not the blood with them. Choler, truly, may by ſome other means be inflamed, which is every where among hot blood. Finally, the valve would be broken by the violence of Spirits, and greater danger might follow thereby, then if the Gall-bladder were broken, an Example whereof *Salmuth* relates.

The Gall-bladder hath received very many ſmall *Paſſages*, furniſhed with ſundry little twigs, ſowed up and down in the Liver, between the Roots of *Cava* and *Porta*; which afterwards being joyned into one paſſage, do carry pure Choler into the Gall-bladder: and the Gall-bladder having diſgorged it ſelf into the Gut, is daily filled again, and ſo it continues that courſe. Contrary to the Opinion of *Arniſæus*; that the Bladder is filled with Choler, which being hindred by the Chylus, from deſcending by the *Porus biliarius*, into the Guts, does drive back again into the Bladder, For I have often ſeen *Walæus* demonſtrate, how that the Bladder being never ſo little ſqueezed with a mans hand, even when the Guts are full of Chyle, Choler is eaſily ſquirted into the Guts.

Its Veins and Arteries. It hath two very ſmall *Veins* to nouriſh it. Alſo it hath very ſmall Arteries from the Cœliaca, to nouriſh and preſerve Heat. It is not therefore nouriſhed with Choler, as *Joubertus* conceives. It hath a little diminutive Nerve, ſcarce viſible, from a little Branch of the ſixt pare, which crawls up and down the Coat of the Liver.

Its Uſe. Its uſe is to receive yellow excrementitious Choler, pure and thin (not the Excrement mingled with the Blood, as the Kidneys do) and to retain it ſome while, and then to expel it.

Now touching the *uſe* of this Choler, Learned men are of ſundry minds. Some with *Ariſtotle* will allow it no uſe, only it was a thing could not be avoided, and is drawn away, that the Blood may not be defiled; which Opinion *Conringius* maintains. Others attribute more to Choler, and make it uſeful to the whole Body. 1. In that it warms the Liver, according to *Haly-Abbas* and *Abenſina*, and by that means comforts the ſecond Digeſtion, and helps the Natural Heat of the Liver, like fire under a kettle. Yea, it heats the whole Body, if we will credit *Nemeſius*, eſpecially the Stomach, to further its Digeſtion. If that be true, we muſt underſtand it of a moderate quantity thereof; otherwiſe an over great Heat of Choler would burn the Stomach.

2. Of kin to theſe, is the Opinion of *Helmont*; that it is the balſom of the Liver, and the whole Blood, brought from the Liver to the Meſentery, and that therefore the Gall precedes in the work of Sanguification, and the Liver follows: alſo he ſayes it hath the conſtitution of a neceſſary Bowel. But how ſhould it come into the Liver, ſince Anatomy doth teach, that this humor is brought out of the Liver, but not carried back thither. For, the way is too long, through the Meſentery, where by reaſon of its acrimony, it makes haſt out, or the edge thereof is blunted. And of what ſhall it be bred, if it go before the Concoction of Blood? There are few Veins and Arteries diſperſed there abouts, but ſtore of Choler is collected. That the Action of the Liver goes before that of the Gall, Children in the Womb do ſhew, in whom the Liver is full of blood, before the Bladder ſwell with Gall, or be ſo much as lightly colored therewith.

3. Their Opinion is not much unlike, who conceive that Choler preſerves the neighbouring Parts, and the Liver it ſelf from corruption, which *Zerbus* would therefore prove, becauſe when the Gall-bladder is removed from the Liver, the ſubſtance thereof where the Gall-bladder lay, does preſently diſſolve and melt.

4. A greater number of Authors will have it to ſerve to expel the Excrements of the Belly, by ſtrengthening the Guts with its Heat, or provoking them to Expulſion by its Acrimony. For although the Choler-paſſage, be implanted into the beginning of the Gut Jejunum, or into the Duodenum; yet it hath an eaſie paſſage to the Colon and Ileum. That it paſſes through the Jejunum, is manifeſt from its yellow color, and the quick paſſage of the Chyle there through. Howbeit, it ought to be moderate in quantity, otherwiſe the Belly is dried and made coſtive, or too much looſned.

5. I add, that it makes the Dung liquid, and apt to paſs, to which intent Painters uſe it to temper their colors.

The other Receptacle of Choler, is the *Canalis* or *Porus biliarius*, the Choler-paſſage, which is found even in thoſe Animals which have no Gall-bladder, as the Hart, the Deer, the Camel, the Roe, the Dolphin, the Sea-calf, &c. It is a veſſel round and long, and the paſſage thereof is twice as large as the Neck of the Gall-bladder, and it goes right out from the Liver [being ſometimes forked, yet ſo that its two branches do ſoon become one, according to the Obſervation of *Riolanus*] through the common paſſage into the Gut (not into the Gall-bladder, as *Fallopius* conceived) receiving a thick cholerick excrement, which may plainly be perceived, if the ſaid paſſage be opened and blown up, for then the Gut ſwells, and not the Gall-bladder. And *Riolanus* obſerved that ſome have died of a Dyſentery proceeding from Choler, in whom the Neck of the Gall-bladder was obſtructed, but the *Porus biliarius* or Choler-paſſage, very much enlarged. Which alſo was known to *Galen*, who will have Choler to be forced right forwards, even from the Liver into the Gut Duodenum: And next to *Galen* we are beholden to *Fallopius* for the true Deſcription of this Choler-paſſage.

Porus biliarius.

Ductus communis naturalis, the common Paſſage, which goes into the beginning of the Gut Jejunum, or *meſaraica*, about

Ductus communis, the common paſſage natural,

about the end of Duodenum, is made up of the Necks of the Choler-passage, and of the Gall-bladder, and is obliquely inserted between the two Coats of the Gut, the length of a finger, and sometimes it is parted into two, having loose Membranes, from the inmost and middle Coat of the Guts, before its Orifice. Where there is plenty of Choler, as in cholerick Natures, it often flows back into the Stomach, so that such persons fasting, are often griped in their Bellies.

Preternatural. Sometimes though seldom, this Passage goes into the bottom of the Stomach, and there empties Choler. Whence proceeds Vomiting of Choler, and such persons are termed *Picrocholoi ano*, Choler-vomiters. Which is seldom found in ravenous Beasts, according to the Observation of *Argenterius*; as also in Dogs by the Observation of *Walæus*, contrary to the Opinion of *Akakia*. But in case this passage be inserted into the end of the Gut Jejunum, such persons are ever troubled with cholerick Loosnesses, and are termed *Picrocholoi cato*, Choler-purgers by stool. Such as he must needs have been, in whom the Choler-passage was inserted into the Gut Colon, as *Severinus* observed, when he dissected the said party at *Naples*.

Chap. XVI. *Of the Spleen.*

Situation of the Spleen, LIen or *Splen* the Spleen, is seated under the short Ribs on the left side, just over against the Liver, as if it were a second Liver, under the Midriff, between the Ribs and the Stomach, being in some higher or lower then in others. Yet in all it is nearer to the hinder or back-part, seeing it rests upon the Vertebraes and the bastard Ribs, so that a man cannot feel it with his hand, unless it swell, and so become nearer to the Belly-rim; and this situation of the Spleen is seldom so changed, as to find the Liver in the left side, and the Spleen on the right.

See Table XV.

Its Number. It is for the most part only one, seldom two (as *Aristotle* observes in the 4. *de Generatione Animalium*, Chap. 4. And *Posthius* at *Montpelier* and *Panarolus* at *Rome*) and more rarely three one upon another, though not all of like bigness (as *Fallopius* observed) but a most rare case it is for the Spleen to be wanting (as *Aristotle* hath observed in the place forecited, and also *Laurentius* and *Schenkius* concerning one *Matthias Ortelius*, and *Hollerius* in a certain Girle) nor can it naturally be wanting, because *Nature abounds not in things superfluous, nor is wanting in things necessary.* That vulgar Opinion is therefore fabulous, which holds that it may be taken out of the Body without danger of death, and that in such as used to run Races, it was usually taken out, which never any man yet saw or recorded, excepting *Pliny*, *Flud*, *Fiorovanta*, *Rousseus*, who if they speak truth, doubtless those persons made a very bad shift to live, or died soon after, for want of that most noble Bowel, or only the outward part of their Spleen was cut off. For deep Wounds in the Spleen are to be accounted mortal, because of the plenty of Arteries, and the consent it hath with the principal Parts of the Body. This Conceit sprung *Questionless* from that old Opinion of *Erasistratus*, who conceived that Nature had made the Spleen in vain, which Opinion *Plautus* also follows in his Comedy

Whether the Spleen may be taken out of the Body.

called the Merchant. And others follow them, who are so far to be born with, if they shall say it is not necessary in reference to all kinds of Live wights, but only in respect of some sorts. For such live Creatures as have no bladder do want a Spleen without detriment, as the Chamæleon, and many others. Insects have no Spleen, and therefore that Proverbial Speech is false: *Habet & musca splenem, even a Flie hath a Spleen.*

Why a man hath a large Spleen. It is not so great as the Liver, yet in Mankind the Spleen is sufficiently thick and big, not so much because of the stubborn humor which it is to master, and is hard to overcome, as because of the Arterial, fermentative, or leavening, and yeasty Blood, which it was to contain. For it is six fingers long very near, three fingers broad, one finger thick, of which greatness it is not found in any other living Creature. Yet is its bigness various, according to the variety of Subjects, and the several Constitutions of Men. 'Tis thought to be larger in such persons, as have Naturally a greater quantity of Melancholy or acid Juyce then others have, which flowing thereunto, it is soon augmented by reason of its loose and spungie substance. Those persons whose Spleen is over grown, are lean, and bad colored. Whence it was that the Emperor *Trajan* termed the Exchequer a Spleen, because as the Princes Exchequer is inriched, the People are impoverished; so as the Spleen increases, the Body pines. They who conceive it elaborates the Chylus, do bring this for a reason, viz. that it draws too much Chyle by the *Ramus splenicus*, and defrauds the Liver. But because that Action of the Spleen is questioned, another reason must be sought after. The most renowned *Conringius* allows the Premises for true in a præternatural greatness of the Spleen, otherwise, if it be Natural and legitimate, the Body flourishes when the Spleen does flourish.

Be the state of the Spleen what it will, I conceive the Body is diminished, when the Spleen is augmented, because it bereaves the rest of the Body of the fermentative acid Juyce, and either consumes it to nourish it self, if it be naturally great; or is unable to prepare and expel it, when its greatness is præternatural and sickly.

Its Shape. Its Shape is for the most part like on Oxes tongue, whence some have called it *linguosum Viscus*, the Tongue-bowel. On the outside towards the Ribs and the Midriff, it is a little bunching and bossie; sometimes it hath marks made in it by the Ribs, being hollow on that side, which is towards the right hand, by reason of the stomach which lies close by it: Where all along the middle part, there is a certain white Line, with prominencies in it, which admits Veins and Arteries with the Caul. Howbeit, præternaturally it receives sundry Figures, viz. exactly round, triangular, sharp-pointed, *made rough* with eminencies, divided into two parts; as *Archangelus* hath rightly observed.

Its Color. Its *Color* in a Child in the Womb is red, like that of the Liver, because it is nourished with pure Mothers Blood: But in persons come to age, it is blackish, because of the thick blood wherewith it is nourished, and in such as are yet older, it becomes black and blew. I have observed it red in grown persons, and *Vesalius* before me, as also *Spigelius* who therefore beleives, that such as have it blackish are unhealthy. *Conringius* thinks that black color is caused by Intemperance in eating, and in drinking especially. I do attribute much to the temper of particular persons in this case, and to the variety of Heat. Now the Spleen does præternaturally put on many colors, according

cording to the Humor prædominant, as black and blew, aſh-color, &c. In Beaſts of hot Conſtitution, it is blacker then in Mankind, and in Swine it is whiter.

Connexion. *It is knit* by thin Membranes ariſing from the Peritonæum, to the Peritonæum it ſelf, the Call, and the left Kidney, ſomtimes alſo to the Septum, which *Fernelius* denies, nor can he be excuſed, unleſs we ſhall ſay he intended the Centre of the Midriff, for thereto it is not faſtned. But in its hollow part, it is knit to the upper Membrane of the Caul, from which alſo (according to others from the Peritonæum, or as ſome will have it, proper to it ſelf) it receives,

Its Coat. A *Coat* thin and ſingle, yet thicker then the Membrane of the Liver, which in aged perſons is oftentimes hardned, ſo as to become bony and griſtly. It ought to be thicker, that it might be ſtronger to endure the force of the Arterial Blood.

Subſtance. Its *Subſtance* or Parenchyma, is like thick, black, and congealed blood.

Its Veins. It hath *Veſſels* of all kinds.

It hath from the *Vena Porta* a remarkable Trunk, which is called *Ramus ſplenicus*, ſcituate far beneath the Liver, and ſent athwart unto the Spleen. The numerous branches of this bough, being for the moſt part ſmall as Fibres, are ſpent in the Spleen, ſaving two which ſometimes paſs out of the Spleen: The one is called *Vas breve*, entring into the ſtomach, ſometimes by one, otherwhiles by more branches [which more frequently, as *Walæus* informs us, is a little branch of *Vena ſplenica*, which when it is come to the middle ſpace betwixt the ſtomach and the Spleen, it is divided forkwiſe into two twigs, one of which goes to the Spleen, the other to the ſtomach] which veſſel ſome will have to belch out acid blood to provoke appetite, or to ſtrengthen the ſtomach, which is afterwards voided by the Guts. Another branch goes unto the Fundament, and makes the internal Hæmorrhoid Veins.

Its Arteries. It hath many and great *Arteries* from a branch of the Cœliaca, which the Liver hath not. 1. To cheriſh life and inbred heat. 2. That the Blood might be more ſtrongly altered. 3. That for its own Nouriſhment, it might receive blood, and withal prepare acid Juyce brought thereunto, with Arterial blood, for to ferment the Chyle and all the Blood.

Its Anaſtomoſes. Now we are to take ſpecial notice of the frequent *Anaſtomoſes* of the Arteries of the Spleen, with the Veins thereof, eſpecially one remarkable one, before the Entrance of the Veſſels into the Spleen: the reſt are in the Spleen.

Alſo we muſt obſerve its *little Nerves*, ariſing from the leſt Coſtal branch of the ſixt pare, diſperſed rather through the Coat, then the Subſtance thereof.

The *Action* of the Spleen is by ſuch Doctors as follow the old Opinion ſaid to be chiefly threefold. 1. To draw melancholick, excrementitious, and ſlimy Humors out of the Liver. 2. To ſeparate the melancholick Excrement therefrom, that it may be nouriſhed by the good blood. 3. To void it being ſeparated, into the Stomach and Guts. Alſo they ſay that the nutriment of the Spleen is elaborated and broken by the Arteries, becauſe ſpongy and looſe fleſh ought to be nouriſhed with vaporous and ſubtile blood. The Paſſages by which the melancholy Juyce is ſaid to be belched forth, are firſt the *Vas breve*, and then the Hæmorrhoidal Vein. They will have the Spleen therefore to be the Receptacle of the melancholick Excrement, or of thick dreggie Blood ſeparated in the Liver (even as the Gall-bladder receives the yellow Choler) and that therefore the Spleen is ſet juſt over againſt the Liver.

Whether the Spleen receive Melancholy from the Liver?

Howbeit I deny that the Spleen is ordained only to receive an Excrement; For

1. In the Spleen there is no large cavity receiving, as in the Gall-bladder, and in the membranous hollowneſs of the Kidneys, and in the Bladder.

2. If it were a Receptacle for Excrements, why was it not ſeated in an inferior place, that it might more conveniently receive the weighty Excrement as other Receptacles?

The argument of Rondeletius *invalid.*

3. *Rondeletius* denying that the ſpleen is the Receptacle of Melancholy, gives this reaſon: becauſe that humor while it is naturally diſpoſed, is all conſumed upon the bony, and other hard and dry parts; and ſeeing it is in us the leaſt in quantity of all humors therefore there is no part ordained to receive it, no more then there is for bloody Excrements, which paſs away by Sweat and inſenſible Tranſpiration. Yet I conceive this Argument is not very ſtrong.

4. Why are there no Branches of this Receptacle ſpred through the ſubſtance of the Liver, or at leaſt of the *Ramus ſplenicus*, even as the Gall-bladder receives Branches ſpred up and down the Liver?

5. Why are there not ſome Paſſages, which carry this Juyce from the Liver.

6. No part is nouriſhed with an Excrement, notwithſtanding the Saying of *Columbus*, that no part is nouriſhed with an Excrement ſaving the Spleen.

7. It is abſurd that an Excrement ſhould flow back into the *Vena porta*, and afterwards into the *Ramus ſplenicus*.

8. It ſhould receive in, and purge forth Excrements, by the ſame Paſſages.

9. The ſtrongeſt reaſon, that the Spleen is no Receptacle of Melancholy is, In as much as it is another Organ of Sanguification, as ſhall be proved by and by.

Whether the Spleen make Blood?

Later Anatomiſts have conceived, that the Spleen doth elaborate Blood, as the Liver doth, but they are not agreed, touching the way, nor the Nature of the Chyle. *Caſparus Bartholinus* my Father was of Opinion, that the Spleen did *make* a *thick*, but good ſort of Blood, of the thicker part of the Chymus, which by an inbred Faculty it hath, it draws to it ſelf, through the *Ramus ſplenicus*. This he proved,

1. By the likeneſs of the ſtructure of the Spleen, with that of the Liver. For as the Liver is a fleſhy Bowel, covered with a Coat, furniſhed with very many Veſſels, the fleſh whereof reſembles blood, ſhed round about: Even ſo, the Spleen is a Bowel, furniſhed with a Coat, and with very many Veſſels variouſly interwoven, whoſe proper fleſh is as it were congealed blood, ſhed round about the Veſſels.

2. In the Spleen, there are very many textures of the Veſſels and infinite Anaſtomoſes. Now there are no where ſuch textures, and plications, or foldings of the Veſſels, ſave for a new elaboration, as may be ſeen in the Brain, Liver, Stones, Duggs, &c.

3. It appears from the Scituation of the *Ramus ſplenicus*, which is far beneath the Liver, out of the Trunk of *Vena porta*, where part of the Chymus is attracted, or of the Chyle, which hath ſome diſpoſition towards blood; If therefore it receives matter there, of which blood is made, why therefore ſhall not the Spleen make blood?

4. Nature

4. Nature is wont either to double the Parts of the Body, and set one on each side, as appears in the Kidneys, Stones, Lungs, Duggs, Organs of the Senses, &c. or if she makes only one, she is wont to place it in the middle. as the Heart, Stomach, Womb, Bladder, Nose, Tongue, Mouth, &c. Therefore the Spleen must needs be another Liver.

5. Diseases of the Spleen, as well as of the Liver, do hurt Blood-making or Sanguification.

6. Somtimes the Situation of the Liver is changed, so that it is in the left side, and the Spleen on the right.

7. The Liver failing and growing less, the Spleen is augmented, and assists the Liver, as is known by many Examples, whence the Spleen hath been often seen in Dissections, to be greater and redder then the liver.

8. Tis unlikely that so many Arteries enter into the Spleen, for the sake of Excrements, but rather to digest & concoct thick Blood, that so by contrary thinness, the stubborn thinness of the said Blood may be overcome.

9. In a Child in the Womb, the Spleen is red as is the Liver, by reason of the cause aforesaid.

10. Such as the Diseases of the Liver are, such in a manner are those of the Spleen.

11. And the Diseases of the Spleen and Liver, are cured well near with the self same Remedies.

12. If Authorities are of force, enter *Aristotle* in the 3. Book of the Parts of living Creatures, Chap. 7. where he saith, that the Liver and Spleen are of a like Nature; also, that the Spleen is as it were an adulterate Liver, and where the Spleen is very little, there the Liver is Bipartite, or of two parts, and that all parts in the Body almost are double. *Plato* calls the Spleen an expres's image of the Liver. Others call it the Livers Vicar, the left Liver, &c. *The Author of the Book touching the use of Respiration*, hath confirmed this, as also *Aphrodisæus*, *Aræteus*, and others. *Archangelus* makes another use of the Spleen to be, to make more plenty of Blood.

For what Parts the Spleen makes Blood?

If any shall demand, *To what end serves the Blood which the Spleen makes?* Some conceive it serves to the same end, with that of the liver, viz. to nourish the whole body, and to assist the liver.

But he was of Opinion, that this was not done save when necessity requires, in some defect or Disease of the Liver.

But he conceives that ordinarily the Spleen is an Organ to make blood, *to nourish the Bowels of the lower Belly*, as the Stomach, Guts, Call, Mesentery, Sweetbread, &c. and that the Spleen it self is nourished with some portion of the said Blood, and sends the rest to the parts of the body. And he conceives that the liver makes blood for the rest of the parts, especially the musculous parts. And he proves it,

1. Because the bowels of the lower Belly receive their nourishment from the *Vena splenica*, or from the branches yssueing therefrom, namely from the branches of *Vena portæ* only, and not from the *Vena cava*.

2. Because those bowels are thick, more earthy and base: And such as the like parts are not found in the body besides, and therefore these parts stood in need to receive such blood from the Spleen.

3. And therefore the liver is greater, because it makes blood for the whole body besides: The Spleen less, because it makes blood only for the lower Belly, save when in cases of necessity it is forced to help the Liver.

4. In Dogs the Spleen is long and thin, because the Parts or Bowels of the lower Belly are smaller in a Dog, and less wreathed and folded, then in a Man.

5. There is an evident difference between the Fat bred in the musculous Parts, or those which are nourished by the *Vena cava*, and that dirty, and soon putrifying Fat, which is bred in the lower Belly, as in the Cal, Guts, Mesentery, &c. Hence arise so many Putrefactions in the mesenterick Parts. And by how much an Humor is thicker (as is the muddie Fat we speak of) so much the sooner it putrifies: As the dreggie fat doth sooner, then the Fat in musculous parts. So the Blood of the Spleen is more disposed to Putrefaction, then that of the liver, and this then the blood of the right Ventricle of the Heart. Moreover, the blood of the Arteries is less subject to Putrefaction, then any of the former; and the Spirit least of all.

6 He believes this to be a most strong Argument, that where a part is found having the substance of the Bowels, there also there are Veins from the *Vena portæ*, or the branches of the Spleen: but where a part is consisting of musculous flesh, there are Veins which have their Original from *Vena cava*, as appears in the *Intestinum rectum*, in which by reason of its twofold substance, Nature hath placed two sorts of Veins. In the musculous Part, there are the external Hæmorrhoid Veins, which arise from the *Cava*: In the bowellie or guttie substance, there are veins from the *Vena portæ*.

These, and such like Reasons prevailed with my Father of pious Memory, to prove that the Spleen drew Chymus, by the *Ramus splenicus*. Which Opinion was at that time embraced by most Anatomists, as *Varolus*, *Posthius*, *Jessenus*, *Platerus*, *Bauhinus*, *Sennertus*, and *Riolanus* in his first Anthropographia. But that Age deserves excuse, as being ignorant of what Posterity hath since found out. For the milkie veins discovered by *Asellius*, do shew, that no Chyle thick or thin, is drawn by the Mesaraick Veins, or carried any whether, but by the milkie Veins only to the Liver, and not to the Spleen. Moreover, a Ligature in live Dissections declares, that nothing is carried through the Mesaraicks to the Spleen, but contrariwise from the Spleen to the Mesaraicks. Yet I allow thus much to the foresaid reasons, that there is a certain Generation of Blood made in the Spleen, by the manner hereafter to be explained, not of Chyle, which hath here no Passages, but of Arterial Blood, sent from the Heart.

Whether any portion of Chyle be carried to the Spleen, and what way?

Hofmannus and *Spigelius* bring the dreggie part of the Chyle, through the mesaraick Veins unto the Spleen, that it may be there concocted into Blood. Who are in the same fault. For the Arteries are ordained to carry blood to the Mesentery, which is very manifest by Ligatures, and it is contrary to the course of Nature, for the blood to be carried, and the Chyle brought back the same way, least they should be mingled together. Moreover, in live Anatomists, there was never any Chyle observed there. And the dreggie Portion of the Chyle, which no part stands in need of to nourish it self, is more fitly purged out by the Guts.

Sperlingerus a learned Man, conceives that this work is performed by the milkie Veins, as to the Liver. Which were a ready way, if the milkie Veins do go to the Spleen, which no man as yet hath been able to observe. Those that thought otherwise were deceived by nervie Fiberkies.

Others who very well saw, that the Mesentery sent nothing to the Spleen, would have the Chyle to come right out from the Stomach to the Spleen, by waies manifest or hidden. They account the manifest waies to be the *Vas breve*, and its branches, by which the spleen sucks the more watry part of the Chyle. But the *Vas breve*, carries acid Juyce from the Spleen, but nothing

to the Spleen, no more then the other Veins. Moreover, somtimes it is not inserted into the Spleen, but there is a Branch of the *Splenica* without it. I omit, that the *Vas breve* is never full of the white liquor. *Daniel Horstius* indeed hath in this case substituted the *Vena splenica*, but contrary to Experience, and the Office of the Veins. The splenick Vein receives all its blood from the Spleen and its Arteries, and returns nothing, and therefore being bound in living Anatomies, it is filled, and swells towards the Spleen, according to the Observation of *Walæus*, but towards the Liver it is emptied. Howbeit *Regius* appeals to the Ligature, that the *Vas breve* swells betwixt the Ligature and the Stomach, and that it is lank between the Ligature and the Spleen. *Bachius* is nothing moved herewith, though he cannot untie the knot, and *Hogeland* is various in this Observation; so that I much doubt, whether the *Vas breve* is alone so filled, before I shall see it attested by the Eyes of some others.

Besides the *Vas breve*, *Carolus Piso* proves that the wheyish and potulent matter, is drawn out of the Stomach, by the Gastrick and Epiploick Veins; who was ignorant of the motion of humors in these veins. Both the vessels disburthen themselves into the *Ramus splenicus*, and then the blood is sent by a straight Passage unto the Liver, and returns unto the Spleen, without any hindrance of the Valves.

Those who are for hidden Passages, would force upon us, either the Pores of the Stomach, or a distinct vessel, to us as yet invisible and unknown. Among the former is *Veslingus*, among the latter *Conringius*, who nevertheless differ, touching the Concoction of the Humor. *Veslingus* will have the Spleen to make blood of the more watry Portion of the Chyle, with the earthy and slimy parts mixed therewith, drawn by the invisible Pores, like the milkie veins, resting upon the stomach it self, and the Pancreas. *Conringius* will have only the potulent liquor to pass by a vessel to us invisible, by reason of the close sticking of the Spleen to the stomach, and the Serum therein contained, which is not so white: Which Vessel will at one time or other be discovered. But all would be well, if those men that have eyes in their heads, would shew us either those Passages, or that peculiar Vessel. The Pores are too narrow for the dreggie parts of the Chyle to pass through, and who can hinder them sweating out some other way, rather then into the Spleen? Many times when the Spleen stuck not so close to the stomach, I could see no vessel, nor could I see any such thing in a Youth, who having largely drunk, was here lately choaked with a bit of a Neates-tongue.

Howbeit, *Reusner*, *Piso*, and *Conringius* lately praised, do suppose, that only potulent matter, is by the Spleen presently suckt out, and that therefore it makes only watry Blood ordinarily. But there is no strong and sufficient reason for this Opinion, seeing there are no manifest Passages. Nor must it only draw that which is thin, which both the Blood and Chylus stand in need of, as a vehicle or carrier, though it flow not alone, but is variously mixed with grosser matter, according to the Constitution of the blood; till having plaid its part, it is either separated by the Kidneys, or sweats through the whole Habit of the Body. If the wheyish moisture be præternaturally separated in the stomach, from the thicker Chyle, either it is voided by Vomit, and the grosser Chyle wanting the help thereof to carry it, will make the Colick in the Guts, as I saw in our famous *Wormius*; or it is voided through the *Pylorus*, which is alwaies open for liquid meats, and such as are easily digested, according to the Observation of our most desired *Walæus*; much more after much drinking, which is somtimes in great Drinkers, quickly voided by urin, not passing through the Spleen, but through the Guts, if there be a conveniency of quality, thinness of Humors, loosness of the Vessels, and strength of the attractive Faculty. All which conspiring, *Asellius* rightly avouches there is no way so long, which is not soon passed over. In such as are otherwise constituted, Drink does not so soon slip away by Urin. For some will drink all day, and never use a Chamber-pot. In some also their Belly becomes loose, and the Drink goes away, questionless, by the Guts. The blood, indeed, of Splenetick persons, is thin and watry, not that it comes such immediately from the stomach, but the fault is in the whole blood, communicated by the Arteries to the Spleen. I pass over, how that these are the signs of a disordered Spleen, from the præternatural state whereof, no good Argument can be drawn to prove any thing, touching its Natural condition; by which Answer, all other Arguments brought by most learned men, for this potulent Chylus are answered.

What Creatures have no Spleen?

It is a doubtful question, why only such Creatures have Spleens, which have Kidneys and Bladders, according to *Aristotle*, which *Panarolus* found true in a Chamæleon. Is it because of the Attraction of wheyish Humors? I cannot beleive it. But they have no Spleen, because they make little blood, and therefore the wheyish Humor did not want peculiar Receptacles, but the Superfluities of the blood is spent upon Feathers, Skin, Scales, &c. They are therefore without a Spleen, because Fermentation was not necessary, in the imperfect Concoction of those kind of Creatures, who have a perpetual and Natural Lientery.

Riolanus hath lately in his Enchiridion out of all these Opinions, hammer'd a mixt action of the Spleen, to attract slimy Blood for its own Nourishment, and after that to pour out a certain particular fermentative Whey, through the splenetick Arteries into the stomach, and because its flesh is of a drinking Nature, to draw and suck superfluous Liquor through the Veins out of the stomach. To which I have already answered, part by part. The Action verily of the Spleen is more noble, then to receive superfluous Humors out of the stomach. And through what Passages should it do that? For the Office of the Veins is, to carry back the blood in the parts, out of the Arteries to the Trunk, according to the Doctrine of the Circulation, which *Riolanus* does here vainly oppose. And Ligatures in living Anatomies do shew the same.

Franciscus Ulmus, *Carolus Piso*, and *Æmilius Parisanus*, will needs have it that the Spleen makes Arterial blood, for the left Ventricle of the Heart, as the Liver doth for the right Ventricle. Which Opinion is confuted, because, 1. There is no way by which the blood here made, can go into the left Ventricle of the Heart; for it cannot go by the *Aorta*, because of the Valves there placed at the mouth thereof. 2. There would be a mixture of perfect and imperfect Juyce, if by the same way, and at the same time the Heart should receive and return blood. 3. Many Creatures live without a Spleen, which generate Vital Spirits nevertheless.

Mr. De la Chambre in his Treatise of Digestion, supposes that the Spleen makes Spirits for the use of the Belly. But there is Spirit enough to nourish and vivifie the inferior Parts, supplied from the *Aorta*. But if he understand some qualification of the spirituous blood accommodated to the use of the belly, he deserves to be excused.

Helmont

Whether when one Kidney is diseased the other ceases to perform its office?

might draw the wheyish Humor; but I am not of the Opinion of *Severinus* and of *Lofolius* after him, that one Kidney being diseased, the other draws the wheyish Humor. For the contrary is seen in such as have one Kidney only stopped with a great stone, or consumed by an Ulcer; and the contrary to what he imagines, is seen in other parts, for one Eye being hurt, the other sees; and all the scollups of the Lungs being consumed on one side, that on the other side does further Respiration, unless haply both parts be affected by some common Cause, for otherwise they must be forced to say, that that happens only sometimes. There is seldom found only one, and then it is a great one placed in the middle, for otherwise the body should not be well ballanced, nor could the Vessels be conveniently carried. Tis monstruous, when both the Kidneys are joyned into one beneath, and cleave together, as I have seen at *Padua*. Tis more rare to find three or four placed one upon another, or one beneath another.

Their Situation.

They are *situate* under the Liver and Spleen, where they rest upon the Muscles of the Loins, between the two Coats of the Peritonæum, at the sides of the *Vena cava* and *Arteria magna*, under which very great Nerves lie hid, both of the Muscle *Psoas*, and others, which evidently pass this way unto the Thighs. Whence it is that a stone being in the Kidney, a numness is felt in the Thigh of the same side. It is a rare case which *Cabrolius* hath observed, for the Kidneys to rest upon the Back-bone of the Loins. Nor are the Kidneys seated just one against another, least there should be some impediment to attraction, and least some part of the wheyish humor should slip aside. But the *right-side* Kidney is *lowest in Men*, to give way to the Liver, under which it rests immediately, reaching by its end, the third Vertebra of the Loins. It is seldom higher then the left, and seldom are the two Kidneys seated one just against another. The left Kidney for the most part, lies partly under the spleen, but is seldom higher then the spleen. Contrariwise in Brutes, the spleen goes more downwards, and the right Kidney lies higher, and therefore there is a Cavity in the Liver by means of the Kidney, which does not Naturally happen in men. Here some observe that the right Kidney is nearer to the *Cava*, and the left more remote, by reason of the left Emulgent Vein, which is much longer then the right.

Which Kidney is the highest?

Their Bigness.

They are not alwaies both just of one bigness, but for the most part they are. They are commonly of the length of four Vertebra's; their latitude for the most part, three fingers, their thickness that of a thumb, yet the right Kidney is very many times larger then the left, because by reason of the heat of the right part, it draws the wheyish blood more vehemently, unless it be fretted by some Disease, for then it grows lean and thin. Also such as are given to fleshy desires, have larger Kidneys then ordinary. But their Proportion is not alwaies alike convenient for the body.

Surface.

The Surface of the Kidneys, as in the liver is slippery and smooth: It is seldom in Mankind uneven, as if it were composed of many Kidneys or kernels, which any man may frequently find in a Child yet in the Womb. But the Kidney is alwaies so made, in an Ox and Bear, in a Calf, and most curiously of all in a Sturgeon, in which the Kidneys are made up like bunches of Grapes, of triangular and quadrangular dies or tiles as it were after an Artificial manner, as I have demonstrated in the Anatomy of that Creature.

Their Colour.

The Colour of the Kidneys is a dark red, but seldom intensely red. In diseased persons the Kidneys are variously coloured, even as the Liver and Spleen are.

Shape.

The Kidney is shaped like a kidney-bean so called, also like an Asarum leaf, if you respect the plane surface. Externally in the Back or about the Flanks, it is of a round, bunching shape; beneath towards the upper and lower part it is bossie, but in the middle concave and hollow. *Helmont* hath seen the left Kidney triangular, and in the same person the right Kidney not so big as an Hazel-nut. *Hippocrates* compares the kidneys to Apples: Without doubt to the broader sort of red Apples; unless by the word *meloisin* he intended the likeness of the kidneys in man to other Creatures.

Connexion.

They are knit by an external Membrane, which is from the Peritonæum, to the Loins and Midriff, and by the emulgent Vessels to the *Cava* and *Aorta* Vessels, by the Ureters to the Bladder. And the right kidney, to the blind Gut, sometimes also to the Liver, the left to the Spleen and Colon. Hence pains of the kidneys are exasperated by plenty of Winds and Excrements.

Membranes.

They have a double *Membrane*: The first internal one near and proper, being very thin without Fat and Veins, from the external and common Coat of the ingredient Vessels dilated (for a Vein only goes in with but one Coat) which growing very close, makes the flesh more compact, and being turned back inwards, it accompanies the Vessels, enters into, and invests their Bellies. *Another* external from the Peritonæum, which adhares but loosely, whence they term it the *Swath-band* of the kidneys. For it is as it were a coverlid or blanket of the kidneys; and because it is encompassed with much Fat, for the sake thereof, it hath received the *Vena adiposa* so called, that is to say the Fat-vein, so that in fat persons, the kidneys lie quite hidden. Whence he that knows or searches into hidden things, is said to search the Reins. For the Scripture uses two words *Pelajoth* and *Taboth*, the former of which *Mercerus* will have to be derived from a word signifying to perfect and finish, because there is in the Kidneys a power of consulting, and finishing things consulted upon: The latter they derive from *Tiach* a blot, and from the Radical word *tivvach* to daub, or plaster, and crust over, because the Kidneys are crusted, and hidden as it were with Fat. Some indeed explain the Phrase of searching the Reins to be meant of Concupiscence carnal and venereal Delectation, from the word *Calah* to desire, Witness *Rabbi David*, and *Pagnine*, or from *Celi* a Vessel, because in and from the Kidneys is the desire of Venereal pleasures. Howbeit this also is a secret Quest, stoln pleasures Venereal seeking the night and dark places and secret carriages, which I have largely demonstrated in my *Vindicæ anatomicæ* against *Hofman*. Fat is bestowed upon them to preserve the Heat of the Kidneys in regard of plenty of Serum which would overcool them, and to defend the Vessels. There is less about the right Kidney if we beleive *Aristotle*, more about the left, because the Heat of the right Kidney, either suffers it not to congeale, or melts it when it is congealed.

What it is to search the Reins?

Substance.

They have a substance or flesh hard compact and dense, much like that of the

The FIGURES explained.

This TABLE propounds the Kidneys both whole and cut asunder, that the Ingress and Egress of the Vessels might be discerned.

FIG. I. Shews the Form of the Kidneys and of the Emulgent Vessels.

AA. *The common Membrane of the Kidneys compassed about with Fat, and here separated.*
BB. *The Capsulæ atrabiliariæ, or auxiliary Kidneys.*
CC. *The Kidneys.*
D. *A Particle of the proper Membrane of the Kidneys separated from the rest.*
EE. *The Trunk of Vena cava descendent.*
FF. *The Trunk of the Arteria magna descendent.*
GG. *The Ureters or Piss-channels.*
HH. *The Emulgent Veins.*
II *The Emulgent Arteries.*
KK. *The Spermatick Veins, or Seed-veins.*
LL. *The spermatick or Seed-arteries.*
m. *The Vena adiposa or fat Vein from the Emulgent.*
n. *The Arteria adiposa, the fat Artery.*

The XIX. TABLE.

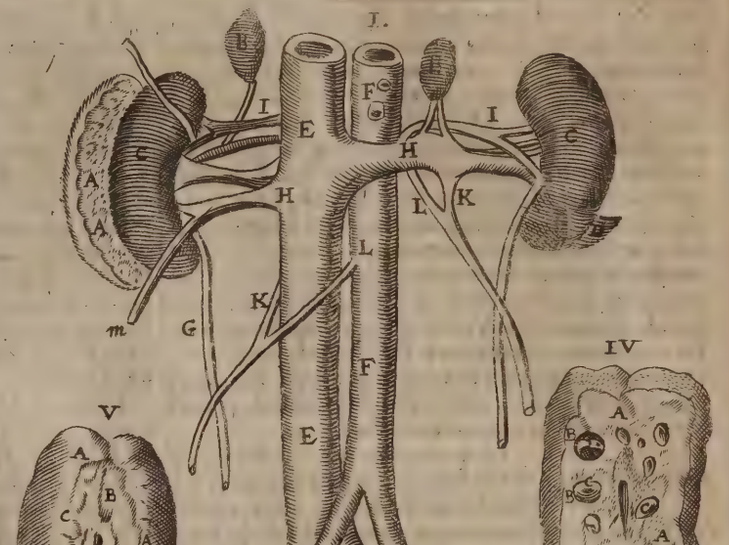

FIG. II. Shews the Entrance of the Emulgent Vessels, into the hollow part of the Kidneys:

AAA. *The inside of the Kidney cut open,*
B. *The Basin of the Ureter.*
C. *The Emulgent Vein spred by sundry Branches into the Kidney.*
D. *The Emulgent Artery variously divided, joyning it self to the little Branches of the Veins.*

The III. FIG. Shews the Rise of the Aorta.

AAA. *The Kidney cut open.*
B. *A large Cavity, or the Basin of the Ureter, about the Kidney.*
C. *The Ureter looking downwards.*
DDD. *Little Pipes embraciug the Caruncles of the Ureter.*

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EEE. *The Teat fashion'd Caruncles or Bits of Flesh, which do strain the Urin into the Kidneys.*

The IV. FIG. Shews the Caruncles.

AAA. *The appearance of a Kidney split open.*
BBB. *The Mouths of the Ureters, which compass the Caruncles opened.*
CCC. *The Papillary Caruncles so called, which strain the Urin into the Kidneys.*

The V. FIG. Shews the Kidney cut open to its Belly.

AAA. *The Kidney divided through the bossie part.*
BBB. *The Caruncles cut through the middle.*
CCC. *The Pipes of the Ureters.*
D. *A Wound piercing into the Belly of the Kidney.*

Heart, but not so fibrous, because the Fibres of the vessels are there. But on both sides of the internal Cavity, the Fat being removed, there appears a loose substance, uneven and hollow. This flesh somtimes is consumed and putrefies, whence comes worms in the kidneys. In a Dog I have seen a worm so great in the right kidney which lay hid like a snail, that beside the external Coat of the kidney, there was none of the flesh left.

Their Bellies.

The kidneys have two *Bellies* as it were, the outermost in the hollow part which *Fallopius* calls *Porta*; through which the emulgent vessels are carried, and first they enter bipartite or divided into two, and soon after they are commonly divided into four, and so spread abroad into the whole substance of the kidneys, till at last they are consumed and spent into very small and fine threads. The inner Belly is nothing but the large Cavity of the Ureter, that is to

say

THE SECOND BOOK; OF THE Middle Venter or Cavity.

The middle Venter what it is.

THe *middle Venter* or Belly termed *Thorax* the Chest, and by some absolutely *Venter*, is all that which is circumscribed above, by Clavicles or Channel-bones; beneath the Midriff; on the foreside by the Breast-bone; on the hinder part by the Bones of the Back, and on the sides by the Ribs.

The fore-part is called *Sternon* and *Pectus*, &c. the Hinder-part, the Back; the Lateral Parts are termed the Sides.

Hypocrates and Aristotle.

Howbeit the Ancients as *Hypocrates* and *Aristotle*, &c. did comprehend all from the Channel-bones as far as to the Privities, that is to say, the middle and lower Belly under the Name of Chest. And therefore in this Sense *Hypocrates* did well write, that the Liver is seated in the Chest: which other unskilful persons not understanding, did imagine that *Hypocrates* was ill versed in Anatomy.

Its Figure.

Its *Figure* is after a sort Oval, though not exactly, and *Hypocrates* compares it to a Tortoise or the Belly of a Lute. In Mankind, it is more bunching in the fore-part, but in the middle of the Breast-bone it is flatter, about the sides round, because of the bowing of the Ribs, in the Back more flat.

Magnitude.

Its *Magnitude* in General, varies according to the different degree of Heat: for by the wideness of the Chest we measure the Heat of the Heart. But in particular persons it is larger towards the lower Belly, where the vital bowels are concealed, and grows narrower by little and little at the beginning of the Neck.

Substance.

Its outer *Substance* is partly bony, partly fleshy.

This middle Belly is not wholly fleshy as the lower is, 1. Because it was not to contain any Parts, that were very much to be stretched. 2. That over-much Fat might be bred there, and hinder Respiration.

Yet is it partly fleshy, because it contains Parts which ought to be moved, as the Heart and Lungs, and for the same Cause.

It could not be altogether bony, like the Skull; for that is a very rare case which *Cardan* mentions in his 11. Book of Subtilties, Page 458. in my Edition, of a Man that instead of Ribs, had one continued Bone from the Throat to the Flanks.

Yet is it in part bony; for to safeguard the noble Parts. For,

Its Use.

Its *Use* is, to contain the vital Parts as the lower and first Belly contains the Natural.

Its Parts.

Now *the Parts* likewise of *this Belly* are either *containing* or *contained*: and the former either *common* or *proper*.

Common.

The *Common* are the same which are in the lower Belly. Howbeit these things following are here to be observed.

The Use of the hair under the arm-pits.

The *Skin* of the middle Belly, is hairy under the Arm-pits. These *Hairs* are called *Subalares Pili*, being useful to keep those Parts from wearing and fretting, in the Motion of the Arms, seeing they exceeding sweaty and quickly sweat, because they are termed the Emunctories of the Heart, receiving the Excrements thereof (in some also that are hotter of constitution and strong-hearted the breast is hairy) as the Groins are called the Emunctories of the Liver.

Why there is little Fat in the Chest.

Moreover, there is little *Fat* found in the Chest, if you except the Dugs, that Respiration may not be hurt by the weight thereof. For by reason of its bony part, so great plenty of the matter of Fat could not flow into it, as in the lower Belly, which is wholly fleshy, and therefore alwayes the fattest part of the body; the middle belly or Cavity is indifferently stored with Fat; the Head is least fat of all. But the fat it self being otherwise white, is wont in the chest to appear a little more yellow then ordinary, by reason of the heat of the vital Parts which lye under the same.

The proper Parts.

The *proper* Parts besides the Muscles, Bones, &c. are the *Dugs* of both Sexes, the *Midriff*, the *Membrane* of the Sides termed *Pleura*, and the *Mediastinum* or Partition-wall.

The Parts *contained* are the Bowels and Vessels. The Bowels, are the *Heart* with its *Heart-bag* or *Pericardium*, the *Lungs* and part of the *Weasand* or *Wind-pipe*, or *aspera Arteria*. The Vessels are *the Branches of the Vena cava and Arteria magna*, underpropped with the *Thymus* or Kernel in the Throat, and sundry Nerves.

Chap. I. *Of the Dugs.*

See Tab. XXV. Lib. I.

According to our Anatomical Method, the first Parts in the Chest which we dissect, as soon as we have done with the lower Belly, are the Dugs. Now we shall treat of the Dugs of Women, casting in between while, wherein those of Men differ therefrom.

Why the Dugs in Mankind are seated in the Breast.

The *Scituation* of the Dugs, is in the middle of the Brest, above the Pectoral Muscle, which draws to the Shoulder. 1. Because of the nearness of the Heart, from whence they receive heat. 2. For Comeliness sake. 3. For the more convenient giving of suck: because the Infant cannot presently walk after the manner of Brutes, but being embraced in his Mothers Arms, it is applied to the Dugs. No other Creatures have Dugs in their Breasts saving the Apes, who hold their young ones in their Arms likewise. *Laurentius* tells us the Elephant does the like, and *Riolanus* sayes as much of the Bat or Flitter-mouse. Some great Sea-fishes of the Whale-kind have Dugs on their Brests, full of Milk, as we lately observed in a Whale that came out of *Norwey*.

Number of the Dugs

They are two in *Number*: not because of Twins; but that one being hurt, the other might supply its Office. Howbeit *Varro* reports, that Sows will have so many Pigs as they have teats. *Walæus* in a certain woman observed three Dugs, two on the left side of her Brest, and one on the right. And *Cabrolius* observed in a certain woman four Dugs, on each side two.

Magnitude.

As to their *Magnitude*. In Girls new born, there is only a Print or Mark visible on the brest, and afterwards by little and little it swells, and in little wenches hardly any thing appears beside the teats, untill by degrees they grow to the bigness and shape of Apples; and when they are raised two fingers high, their Courses begin to flow. In old women they wither away, so that nothing appears but the Nipples, the Fat and Kernels being consumed.

In women they swel more, and in women with child the last moneths, they are more and more encreased.

The difference of the Dugs in men and women.

In men they do not rise so high as in women, because ordinarily they were not to breed milk [yet because of the equality of the kind, it was convenient that men should have them as well as women.] And therefore in men, the Dugs are commonly without Kernels: yet in burly people, the Fat which is under them raised the breasts. In the Kingdom of *Sengea*, the Dugs of women hang as low as their Bellies; and in the Isle of *Arnabo*, 'tis said they turn them over their shoulders to their backs, and there suckle their children.

Their Shape.

Their *Shape* is roundish. They represent as it were an half Globe. And in some because of their over-great weight they hang down.

Their Parts.

The Dug is *divided* into the Nipple and the *Dug* it self. For in the middle of the Dug there is to be seen a peculiar Substance, which,

How the Nipples come to have so exquisite Sense.

Is called *Papilla*, the Teat or Nipple, being spungy, like the Nut of a Mans Yard, and therefore it will fall and rise when it is suckt or handled. For it hath an excellent and exquisite Sense of feeling, because it is as it were the Centre, into which the ends of the Nerves, Veins, and Arteries do meet. Which is apparent from the Delicacy of its Sense, and the redness of its color, a sure token of Blood brought in by the Arteries, by reason of the Concourse whereof, Chyrurgeons do judg Cancers and other Tumors about the Nipple pernicious.

Riolanus believes that the Skin is doubled, and as it were compressed: but the doubling would make it thicker. But the Skin is exceeding tender, easily rubbed off, and apt to be pained when the Child sucks very freely. Only in old women it grows thick. Nor is the Nipple any other where made of the Skin straitned or folded.

If the Nipples turn upwards, a Male child is in the Mothers womb, if downwards a Girl according to the Tradition of *Hypocrates*, which hath not been as yet ratified by the confession of women with child.

As to *Number*, there is one Nipple on each Dug. *Hollerius* saw two Nipples upon one Dug, which both yielded Milk.

Their *Colour* in Virgins is red, in such as give suck it enclines to black and blew, and in them also they are more sticking out, by reason of the Infants sucking; in such as are past Child-bearing, the Nipples are of a black color.

They have a Circle round about them which is called *Areola* the little Parsley-bed, in Virgins pale and knotty, in such as are with child and give suck, brown, in old women black.

'Tis *bored* through the middle, with very small holes for the Milk to pass through: For

The *Use* of the Nipple is to be instead of a Pipe or Funnel, to put into the Mouth of the Infant, whereout it may suck the Milk: Secondly, to serve for a pleasing Titillation, whereby Mothers and Nurses are enticed the more willingly, and with a certain Sense of pleasure to give their children suck.

The Dug.

The *Dugs* do inwardly consist of a Membrane, Vessels, Kernels, or rather kernellish Bodies, and Fat: though the two last do chiefly make up the Dugs; the Kernels and Fat lye concealed between the Membrane and the Skin.

Now the fleshy *Membrane* does fasten the kernellish Substance which it compasses, unto the Muscles which lye thereunder.

The *Kernels* are many: In Virgins more hard, in old women consumed, in such as are with child and give suck, more swelling and pappie. Yet there is one great one, just under the Nipple, which the other lesser ones do compass about, and infinite textures of Vessels lye between them. *Riolanus* hath observed a womans Dug to consist of one continued Kernel, and not of many, the contrary whereto we see in scirrhous and cancerous Tumors.

The *Use* thereof is, to turn Blood into Milk. And the use of the fat of the Dug is to encrease heat, and to make the Dug of an even round shape. And therefore such as have the Fat consumed by some Disease or old Age, they hang ill favoredly like empty Bladders, and are unfit to make Milk.

The *Vessels*. The Dugs receive their Skin and external *Veins* from the Axillary, which are called the *Thoracicæ Superiores, the upper Chest-veins*, which in women with child and such as give suck, are often black and blew visible. They receive other internal Veins, brought thither a long way, that the Blood might be the longer therein wrought, which are termed *Mammariæ*

The Venæ Mammariæ.

mariæ Venæ or Dug-veins, which descend on each side one, from the Trunk of the Axillary Vein, under the Breast-bone, to the Glandules or Kernels of the Dugs. These are met by other ascendent Veins, by the right Muscles, of which before: and therefore the Infant being born, the Blood is carried no longer to the womb, but to the Dugs, and is turned into Milk. And hence it is that women which give suck, have seldom their Courses. Hence also, when the Children suck over-much, Blood comes out at the nipples. Yea, it hath been observed that a womans courses have come away through her Dugs, and Milk by her womb; howbeit, this is a rare chance.

Why Milk is bred after the child is born.

But the Matter of Milk, be it what it will, cannot according to the Principles of the Bloods Circulation, be carried by the Veins to the Dugs. The *Venæ mammariæ* or Dug-veins, do only carry back what remains superfluous, after the Child is nourished, and Milk made. Moreover, they are seldome joyned with the Epigastrick Veins, and they are too few and small, alone to carry so much blood from the womb, as may suffice a Child that is a liberal Sucker.

Their Arterias.

Their *Arteries* proceed from the upper Trunk of the great Artery: and from the Subclavian branches, which are joyned after the same manner with the Epigastrick Arteries, as was said of the Veins. The *Thoracicæ Arteriæ* or Chest arteries, so plentifully and evidently, that in cancerous Tumors of the Dugs, a woman hath bled to death by them, of which case I remember some Examples. Hence it seems more likely, blood is carried to the Dugs to make Milk, which blood being consumed in fat and elderly women they are therefore none of the best Nurses. Hence it is that women which give suck, receive great damage by loosing their blood; contrariwise they are advantaged, by whatever may draw and provoke their blood to their Dugs, as by rubbing them, &c.

The matter of Milk is not Blood as Martianus *holds.*

Now *Prosper Martianus* and *Petrus Castellus* do maintain out of *Hypocrates*, that the matter of Milk is twofold, viz. Blood and Chyle: and that the greatest part of the matter thereof, is pressed out of Meats and Drinks, not yet digested in the Stomach, into the Dugs, by the Child swelling in the womb, and after the Child is born, by the passages made wide by sucking: and that another *small* part is made of blood ascending from the womb, which is rather to be reckoned as an Efficient cause, by reason of its Heat, then of a *Material* cause.

That *Blood* alone is not the matter of Milk, besides the Authority of *Hypocrates*, they prove, because

1. Otherwise it were impossible that a woman should live, voiding two pounds of blood every day, in the form of Milk.

2. When a woman gives suck, her Courses flow, which in the first moneths of her going with child, are suppressed.

3. When a woman left breeding Milk, she would fall into a dangerous Plethory, or fulness of Blood.

4. There would be no Child-bed Purgations at all, the Milk being so violently carried into the Dugs, the second day after Child-birth, that it causes a Feaver.

5. Nature would then have framed greater Vessels from the womb unto the Dugs.

6. The Milk would not retain the smell, and vertue or operation of the Meats eaten, because these things are changed in the blood.

7. The Blood collected into the Dugs, does breed Madness. *Aphor. 40. Sect. 5.*

But arises from the Stomach & the Chyle.

But that it depends upon the *Stomach* and the *Chyle*, these following Reasons evince.

1. The force and efficacy of Purgatives, is after some hours violently carried into the Dugs, as divers Experiments do teach. Yea and our Country-women, when children that have the cough, suck at their breasts, they drink pectoral Decoctions, and believe that the sucking child does presently draw them.

2. If a Nurse do swallow an hair in her meat and drink; it comes into her Dugs according to *Aristotle*, and sticking in the Nipples, it causes the Disease *Trichiasis* or *Hair in the Nipple.*

3. A branch of Cichory according to the Observation of *Martianus*, hath come out of a womans Dug, which she had eaten the night before at Supper: and bran hath been seen in the Excrements of a child that only lived with sucking.

4. Nurses perceive as soon as ever they have eaten and drunken, the going down of the Milk, and the swelling fulness of their Dugs. Yea, and our Nurses are extraordinary careful not to eat, while they give their children suck, for otherwise the children should suck undigested Milk.

5. *Castellus* pleads their Scituation over the Stomach, not near the Liver or Womb, excepting in beasts.

6. The Milk is colder then the Blood, and leaves more Excrement in her that gives suck, then blood does in the Embryo or child in the womb.

Howbeit we find many difficulties in this new Opinion, and those of no small moment.

The said Opinion refuted.

1. There are no manifest passages from the Stomach to the Dugs, which if any man can find, I shall willingly acknowledg my self convinced. *Martianus*, indeed, *Castellus*, *Veslingus*, and *Horstius* do talk of invisible passages, like the milkie Veins, which cannot be discerned in a dead body; or at least they conceive the Pores of the flesh may suffice to admit a passage for milkie Vapors. But the Pores seem too narrow for thick Chyle to pass through, which in the Mesentery did require large milkie Veins, which any body may discern. A subtile Spirit and thin Vapors with smoakie steams, do pass through the Pores, and not the Chylus, nor blood, according to Nature; for if so, then there were no use of Vessels. Nor is the Infant satisfied only with Vapors. I willingly acknowledg, that Nature endeavors the translation of Humors from one part to another by unknown wayes, but she does it compelled, and besides her customary Course, whereas the breeding of Milk is a constant and ordinary thing.

2. The Dugs being heated by any other cause whatsoever, do not breed Milk, but the action is hindred by the said Heat.

3. Nurses confess, that after they have drunk, the Milk does manifestly descend out of their backs, and from about their Channel-bones, and puts them to some little pain. For there the Chest-arteries are seated, and not the Stomach.

4. A tender Infant should be ill nourished with undigested meat, having been used to be nourished with blood before.

5. Out of the Nipples of Children newly come out of the Womb, before the use of meat, a wheyish matter drops like Milk, before they have eaten any meat.

6. What shall we say to that *Aphorism* of *Hypocrates*?

If

If a Woman want her Courses, neither any shivering or Feaver following thereupon, and she loath her Meat: Make account that she is with Child.

7. Cows, when they eat grass after hay, or hay after grass, before the fifteenth day, there is no perfect change either in the Constitution or colour of their Milk or Butter, according to the Observation of *Walæus*; yet they perfectly change their Chyle the first day, but their Blood more slowly. Also our Nurses observe, that after they have slept, and their Meat is digested, their Dugs make Milk, which does not so happen, if they want sleep.

8. *Hogeland* proves by Famines and Seiges, that when all the Nutriment of the Nurse is turned into perfect blood, yet nevertheless Milk is bred in the Dugs.

And the Argument of Martianus, and others are answered

Wherefore until some diligent hand shall have found evident wayes and passages, for the Answering of the contrary Arguments: You are to Note. 1. That we admit of the Chyle as the remote matter of Milk, but not as the immediate matter thereof. 2. That the Blood being plentifully evacuated by the Milk, is bred again by plentiful meat and drink; and therefore the plenty of Milk ceases when there is little drink taken in, as all Nurses do testifie. Moreover, such as are of a Sanguin complexion afford most Milk, whereas those that are of a tender constitution grow lean by giving Suck. 3. That all the blood which is poured out of the Arteries into the Dugs, is not turned into Milk, but only the more wheyish part, a great deal running back by the Veins into the Heart. 4. That Women which give suck have their Courses, because the Vessels of the Womb are then more enlarged, then in the first moneths of their going with Child: and ever and anon they flow sparingly from Nurses, and leave off by fits. Also Women that give suck seldom conceive, unless they be of a Plethorick habit of body, that is to say full of good blood. Our Women when they would wean a Boy, if their Dugs swell, they do by certain Medicines keep back the Milk, by straitning the Vessels, that the matter thereof may not enter nor be drawn that way. 6. That the Breast and Dug-Arteries are large, and are more and more widened by continual sucking. 7. That the Milk doth drink in the faculty of Meats and Purgatives, even by mediation of the Blood, which conserves the color and faculty of the meats, though sundry digestions have preceded; though vapors alone be raised, and the substance ascend not. 8. That many things are performed in the body, according to the singular constitution of particular persons, yea and many things which rarely happen, which is to be understood of the Milk, which was in the Dugs of that *Man* at *Cous*, and of other things thence voided.

Their Nerves.

Nerves are carried from the Nerves of the Chest, especially the fift, for to cause sense, and they end in the Nipple.

Their Pipes.

Besides these Vessels, the Dugs have also white *Pipes*, according to the observation of later Anatomists, springing from the whole Circumference of the lower part which growing narrower, do alwayes meet together, wherein Milk being made, is preserved for use. Whether or no they are nothing but widened Arteries, becoming white, because of the change of the milk and the bordering kernels (which I am willing to believe) I leave to acuter Eyes and Wits to determine. They treasure up the Milk, when there is occasion of omitting to give the Infant suck: and when that use is over, they grow as small as the most Capillary Veins.

The use of the Dugs.

Their Use is, 1. General in Women and Men, to be safeguards to the Heart: hence Nature hath given Men of cold Complexions larger Dugs then ordinary; and Women that loose their Dugs become rough-voiced, according to *Hypocrates*. Nor doth the pectoral Muscle hinder, which performs the same Office, which is *Riolanus* his Objection; for the more noble parts require great fencing, even by the smallest thing, as the Eyes from the Eye-brows, the Heart from the water in the Heart-bag or Pericardium, &c.

II. In women their use is to breed Milk, to nourish the young Infant. For the Child was nourisht by blood in the Womb, and milk is the same blood only whitened, so that Nature seems to have put a trick upon living Creatures by obtruding upon them the gentler appearance of white milk, in place of red blood, as *Plato* hath it. Which is the Cause that the People of *Savoy* and *Daulphine* did anciently prohibit their Preists, the use of milk, as well as of Blood.

The Efficient cause of Milk.

Now the *Efficient* Cause of milk, is not the Womb, where milk was never observed, nor do the Dugs breed milk, by that vertue thereof which it self wants; nor of the *Veins* or Arteries, unless it be the neareſt, can the vertue be communicated from the Dugs. For as for what *Baronius* relates of St. *Paul*, how when he was beheaded, not blood but milk ran from his Neck, either it was a miracle, if true; or a serous humor flowed out, which sometimes flows from the Arm, when a Vein is opened, and I have seen it very like to milk, or finally the Liquor of Kernels being cut, did resemble milk. But the true efficient cause of the milk, is that same kernelly flesh of the Dugs, unto which there is none like, in the whole body. Now it works this moderate Concoction by the propriety of its substance, and by reason of its proper temperament. *Aulus Gellius* conceives the milk becomes white, by Reason of plenty of heat and spirit Book 12. Chap. 1. But I am more enclined to believe, that milk is white, because it is assimilated to the Dugs that are of the same color.

Milk may breed in Virgins, Men, Women not with Child, &c.

Somtimes therefore (though it happen seldom) milk may be bred in Virgins, and in Women not with Child, according to the Observation of *Bodinus* in his Theatre of Nature, of *Joachinus Camerarius* in *Schenkius*, of *Petrus Castellus* touching one *Angela* of *Messina*, of *A. Benedictus* and *Christopher a Vega* concerning a Girle of *Bridges*, and of others. In *Scania* in our Country, a maid was lately accused to have plaid the Whore, because she had milk in her Dugs, which nevertheless she proved to be a propriety of her Family, by producing her young brother who likewise had milk in his Breasts. Infants new born shed a wheyish milky liquor out of their Nipples. These examples are confirmed by the Authority of *Hypocrates* in the 39. *Aphorism* of his *fifth Section*, where Women have milk though neither with Child, nor lately delivered. And this happens, when the Dugs are filled with abundance of spirituous blood, and suppression of Courses be joyned thereto: for then the Glandulous substance digests more then is necessary to nourish the Woman. Yea, in men that are fleshy, large-dug'd, and cold of constitution, a milky humor, and as it were milk is frequently seen; especially if their Nipples be frequently suck'r, and their Dugs rubbed, as

the

comprehended between the lower Vertebra's of the back and the Ribs. Hence great and whaley flesh, because they have longer and more Ribs then we have, have a larger midriff, creeping mean-while as far as to the extremities of the Ribs. For,

An Head and Tail in the Midriff.

For it seems to *arise* from the Vertebra's of the Loyns, by two somwhat long fleshy parts (which cleave to the muscles of the Loyns, at the sides of the great Artery, and growing by little and little wider, about the lowest Vertebra's of the Chest they grow together, where this Muscle begins to grow Circular) and is fastned to the Chest round about, being knit where it is fleshy to the extremities of the Ribs: though we should do peradventure more rightly, to make the beginning thereof, in its whole Circumference, as well from the Loyns as the Ribs, which *Galen* doth also somwhere insinuate: For seeing it could not be knit to the eleventh Vertebra, because of the great Artery, and the beginning of the Lumbal muscle, it is strongly inserted, by its two final appurtenances to the Vertebra's of the Loyns.

Galen somwhere (whom *Sylvius, Vesalius, Aquapendens, Spigelius* and many more follow) will have the middle of the *Diaphragma* to be the Head thereof, because the Nerves are there inserted, and the Centre in a Circle, upon which one point of the compass doth rest, while the other is carryed about, may be well taken for the Head of the said Circle. But as it is a peculiar muscle, in Situation, Action, Figure, Nobility, &c. so hath it somwhat peculiar in this point. But the beginning or Head cannot be in this Centre, because it is moveable, and the Ribs and Vertebræ of the Loyns, in respect thereof immoveable. Moreover, the Nervous or Tendinous part, is the End of the muscles, and not their Head.

Its substance.

Its *Substance* is fleshy, in the middle Nervous and Membranous, where a Membranous *Centre* shews it self and a *Nervous circle* in stead of a Tendon, to which fleshy Fibres do run, from the Circumference of the Chest, as to their Centre. Whence necessarily the middle part of the motive muscle is Nervous, for otherwise it could not be moved. *Secondarily*, it helps to strength, in a perpetual motion, and in the suspension of the bowels which adhere thereunto; moreover it serves to secure the Vessels which pass through. To sustain the beating of the Heart, it was not to be strong, as *Riolanus* suspects, because 1. A soft part doth easily give way and yeild to a blow. 2. The point of the Heart doth not strike against the Midriff in its pulsation, for the Heart smites the breast when it is erected in the Systole, and is contracted at the sides; in the Diastole when it descends to the Diaphragma, it becomes soft and flaggy, and gives no pulsation.

Note that Wounds in the Nervous Centre of the Diaphragma, are by all accounted deadly, whether because a Nervous part being offended, doth induce a Convulsion, or because it cleaves to the Pericardium or Heart-bag and to the Liver, or because respiration perishes, and the Heart placed over the same is likewise hurt; for the Pericardium and Liver being hurt, do admit cure. A wound is more safely made in the fleshy Circumference thereof.

Its Membrane.

It is cloathed with a double membrane, for strength. The upper is from the Pleura, to which the Pericardium or Heart-bag is firmly fastned, and sometimes also the Lobes or Laps of the Lungs by little final Fibrkeies; the lower is from the Peritonæum. Also it hath its proper substance, formerly described.

Its Holes.

It hath *Holes*: some being very exceeding little, and others great. Those very little ones are the Pores, through which vapors arise from the inferior parts. They are widned by the perperual motion of the Diaphragma, not by Odours and Fumes, as *Helmont* believes. Otherwise, because the Membrane is thick, it hinders the drinking in of thick vapors, and will not let them ascend without the Vessels. Among the greater, there is one on the right hand, in the middle of the Nervous part, to give a passage to the Vena Cava: Another on the left hand greater and somwhat backwarder, for the letting through of the Gullet or Oesophagus with two Nerves which go unto the Stomach. And where it arises about the Vertebra's of the Loins, there appears a division, for the through-fare of the great Artery, and the *Vena sine Pari*, or Vein without fellow. These wide holes do admit from the inferior parts, the passage of thick Vapors with the blood, which cannot be prohibited by the Diaphragma. Hence in the 29. *Aphorisme* of the *fift Section* 'tis said, in a Fruitful Women, her lower parts being perfumed, the scent goes up to her Nostrils.

Vessels.

As to its *Vessels*. It has *Veins* and Arteries from the Neighbouring Vessels vena cava and Arteria magna, called *Venæ phrenicæ*: and sometimes from the Vena adiposa

Nerves are spred through its whole Substance; being brought from the spinal marrow of the Neck, between the fourth and fift Vertebra: which is proper to this part, and common to no other internal part under the Channel bones, because according to the Conjecture of the renowned *Hofman*, it was not to lie open to external wounds or Blowes, least we should be masters of our own Life or Death. But instruments of death are every where obvious, which the Love of Life and Fear of God hinders us from makeing use of. Now they are carried through the Cavity of the Chest, and are propped up by the mediastinum. Other Anatomists have observed other Nervs passing that way from beneath, proceeding from the costal and stomachick Branches. And because the Nervs of the Diaphragma or Midriff are in their passage mingled with certain little twigs, which are spread abroad into the muscles of the Jaws and Lips; hence when the Diaphragma is smitten there arises a kind of Laughter, which is no real Laughter, but a counterfeit one such as they call *Risus Sardonius*, the Sardonian Laughter, because the muscles of the Face suffering a Convulsion at the same time, and the Jaws and Lips being moved this way and that way, the partie seems to laugh. Such was the laughter of *Thycenis* in *Hippocrates* and of *Agnerus* in our Countryman *Sarco* his relations, who was cut asunder in the middle with a sharp sword: also of that man in *Aristotle* whose Midriff being in the fight pierced with a Dart, made him die laughing. *Pliny* relates as much of other Fencers, and *Homer* tells us that *Juno* laught with her Lips when her Forehead scowled.

Sardonian Laughter.

Galen makes the Cause of the Sardonian Laughter to be in the Musculus latus quadratus, the broad square Muscle. But it reaches not to the Lips, *Laurentinus Politianus*, makes the spirits to be the cause of this Convulsion, which because of the sense they have of some troublesome thing, run back to the upper parts. *Mancinius* will have the Heart to be widened, and the face drawn into the posture of laughing; by the heat which

is raised by tickling and wounds, because he will have the Heart to be the seat of Laughter, in defence of *Aristotle* whom Physitians have confuted. *Riolanus* has sometimes observed laughter to arise in the guelding of a man, which was the forerunner of a deadly Convulsion; for which cause he condemns our reason drawn from the Nerves, not giving us in the mean time any better reason viz. why laughter should arise upon the wounding or hurting the nerves of the Midriff and Privities, and not when any other nerves are wounded.

Use. Its *Use* is 1 To help free Respiration; for violent respiration is assisted by the muscles of the Chest; the former Respiration *Galen* terms *gentle* or small, which depends only upon the Midriff, the other *strong*, the intercostal muscles assisting thereto, a third *sublime*, where the Diaphragma, intercostal or rib between muscles, and muscles of the Chest do act all together. *Birds* indeed, though they breathe have no Midriff, but their breathing which is light and scarse perceptible, because of the lightness of their bodies, is performed by their Lungs and Chest. Contrariwise *Fishes* which breathe not have a Midriff, but membranous, to seperate one Belly from another. In the greater sort of Sea fishes of the whaley kind, I have observed a fleshy Midriff like that of Creatures which live on the Land.

How the motion of the Diaphragma is performed. Now the motion thereof is thus: when the Breath is drawn in, the Midriff is stretched, when it is blowne out, it is remitted or slackned, contrary to the Opinion of *Arantius* and *Laurentius*. Of whom the latter will have the Midriff contrary to all other muscles to draw towards its end; and he will have the fibres which run out from the Circumference of the Chest, to be equally contracted, and the ribs to be drawn to the nervous Circle, and so to cause respiration. But how can the membranous Centre of the Septum, draw the ribs to its self and contract the whole Chest unless haply because it is fastned to the Mediastinum. But I have observed more then once in dissections of living Bodies, that the Midriff is stretched out, when the Creature draws in its Breath. For the Guts are driven downwards by the Midriff when the Breath is blown out, and they ascend again when the Breath is drawn in, which also any man without Anatomical Section, may perceive in himself, by laying his Hand upon his Belly. In Wounds of the Diaphragma, the Guts and Stomach, when the Breath is drawn in ascend into the Chest, which *Paræus* twice observed, which differs only, according to more or less, from the naturall course of breathing. Now the motion of the Midriff ought to be such, because the Chest when the Breath is drawn in, must be widened to receive and contain the Air and swoln Lungs; and contrarywise, when the Air is breathed out, the Chest ought to be straitned, because then the footy vapours are expelled, and the Lungs flag and become small again, and therefore in the former case the Midriff is lifted up, and in the latter depressed.

Jo. Walæus besides that motion, whereby the fleshy part gives way inwardly, has observed another motion in the Diaphragma during the drawing in of the breath, whereby the fleshy part thereof being contracted into it self, comes to have folds in it, so that one portion of the fleshy part is placed upon another: and he observed that this folding is cheifly about the Appendices or Appurtenances, and when the breath is strongly drawn in: and he conceivs that by this means the Midriff is the more shortened, and the Chest by the lifting up of the Ribs, more widened.

II. To assist the muscles of the belly, in their compression, when they would force out the Excrements and the Child in the womb: for from above it thrusts the Guts downwards. Hence, according to the Observation of *Platerus*, when the belly is costive, Sneezing and Coughing do help, because thereby the Midriff and Dung conteined in the Guts, are driven downwards, because of the Strugling of the said Midriff and its bearing down, the Excrements of the belly and Urine come away of themselves in live Anatomies and in such as are put to death by hanging.

III. To distinguish the lower belly with the natural parts, from the middle belly with its vital parts, least from the Ignoble parts frequent vapours should ascend, to the parts more noble, as the Heart. &c.

IV. According to *Hippocrates*, it is the Fan of the lower belly, which fannes and cooles the *Hypocondria* or parts under the short ribs.

V. Others suppose it causes natural respiration, beause it depends not upon our will and pleasure, and moves when we are asleep, and never so much as think of it, and by help thereof, Men in Apoplexies do for a season breathe. But *Piccolhominius* does more rightly assign a voluntary motion thereunto, howbeit only when some necessity constrains, as in easing of the belly, pissing, and fetching of breath, because it is a Muscle of a nature by it self; but not a motion *absolutely* or simply voluntary, which is discerned in progression & apprehension, that is to say in going and handleing.

Its motion ceases in a strong Apoplexy, only transpiration does then remain: but in a light Apoplexy, we see the Diaphragma also moved with the Chest muscles.

CHAP. IV.
Of the Pleura, Mediastinum, *and* Thymus.

What the Pleura is, and its Original. THE PLEURA or Rib-coate, which the Greeks call *Chitôn hupezocòs*, or absolutely *humèn*, is a membrane which on the inside cloathes the cavity of the Chest, hard and white, but in some pleuretick persons according to *Hippocrates*, black and blew, whence it is that Practitioners conceive that this is affected in the Pleurisie, which notwithstanding is demonstrated to happen secondarily, by *Manelphus*, *Cletus*, *Platerus*, *Zacchius*, *Vitaglianus*, *Benedictus*. It is somewhat thicker and stronger then the Peritoneum. Ariseing from the Coats, which cover the intercostal nerves which proceed out of the Backbone, by means of which it is continued with the Coats of the Brain. And therefore it is thicker in the Back, to whose vertebra's it cleavs as it were inseperably. *Hofmannus* will have it arise from the Breast-bone rather than the vertebra's of the Back, wherein he is out, as I have proved in my *Animadversions* upon *Hofman*, and in my *Anatomical Colledge*. In diseases of the Chest, it becomes many times ten-fold thicker: though others say it is so attenuated in pleuritick persons, that it can hardly be descerned. *Fallopius* saw it of a thick callous substance, in a Dropsie

Its Thickness.

of

of the Lungs, and *Platerus* saw it in like manner swoln by a Scirrhous Tumor.

It is every where *double*, that the Vessels may be carryed within the folding thereof. The outer part which looks towards the Chest, is harder and thicker, the inner part being fastned to the Ribs is thinner. Between these the matter of the Pleurisie is often collected, and not only between the Pleura and Muscles. *Galen* makes it to be single, and will allow it to be double, only about the Mediastinum. *Riolanus* explains that same Duplicature to mean its thickness, which cannot be shewed without tearing. The contrary whereto is manifest in the swoln sides of such as have the Pleurisie.

The place of the matter which causes a Pleurisie.

It hath its inner surface smooth, least it should by its roughness hurt the Lungs; its outer more rough that it might be the stronglyer fastned.

Somtimes it is found furnished with a little fat (as there is also now and then in the Peritonæum) near the Vertebra's of the back, where the Vessels are greater then ordinary.

The Ribs also have their *Periosteum* or Membrane so called, which some call the third coat of the Pleura, and others *Membrana Circumossalis* the bone-about *Membrane*.

It hath very many *Holes*, the lowermore of which I have reckoned up in the History of the *Diaphragma*, the upper are there where it affords passage to the *Vena Cava*, the *Arteria aorta*, the Wezand or *Aspera arteria*, the Gullet and the Nerves of the sixt Pare.

Its Holes.

As for its VESSELS. It hath *Veins* from the solitary Vein or *Vena sine Pari*, and the upper Intercostal or Rib-between Vein; *Arteries* from the Intercostal or Rib-between Artery, and from the great Artery; *Nerves*, twelve in number, proceeding from the foreside of the Vertebra's of the Chest. And therefore wounds in this part are attended with most grievous pains.

Its USE is. I. According to *Galen* to plaster over the whole Cavity of the Chest and to render it smooth and even, that the Lungs migt not be hurt in their motion. 2. To cloath the Chest and its parts on the inside (even as the Peritonæum affords coats to the parts of the lower Belly) and to constitute the Partition Membrane. Or,

MEDIASTINUM, Which is an of-spring of the Pleura, being a double Membrane; separating the Cavity of the Chest and the Lungs into two parts. For after that the Pleura having taken its Original about the Back hath ascended by the sides to the Breast-bone, taking its course again towards the Back-bone, it is carried right out from the middle of the Brest to the Back. Being fastned on each hand to the sides of the Breast-bone, this Membrane is not obscurely double, as is the Pleura, but visibly, being constituted of the Pleura doubled; and there seems at first sight to be as great a space between both, under the Breast-bone, as the breadth of the Breast-bone comes to. But this is only in appearance and not really so; for that same Cavity under the Breast-bone, is then only caused, when the Breast-bone is in dissection, pluckt from the Mediastinum, for before the Membranes of the Mediastinum are most closely united one to another. Which it is strange that no Anatomist did observe before *Ad. Falcoburgius*. After him, I have often made the Experiment, in grown persons and Children new born, in Land-beasts and large Sea-fishes; nor could I shew any Cavity betwixt the Mediastinum and Breast-bone, no not to the most expert Spectators, but I found the Membranes of the former sticking close by certain Fibres to the latter, which we forcibly separated with a Penknife. Which that it might be more apparent, the inwards of the Belly and the Midriff being taken away, I made it visible to the Eyes of all that were present. These things are to be understood of the lesser Cavity (to satisfie *Riolanus* who is my Adversary in this point) between the Membranes of the Mediastinum and the sternum: For the greater, wherein the ever-moveing Heart is seated, no man in his right wits will ever deny. In this greater Cavity, or in this Duplicature if a wound inflicted on the foreside shall penetrate, lightly, so that the Heart settling beneath remain unhurt, it is sufficiently void of Peril and safe enough; which one unskillfull in Anatomy would pronounce deadly, But towards the Vertebræ, the Cavity grows narrow by little and little, and the Membranes meet together. But in the middle the Cavity is wider, and in the fore part of the said Cavity, the Heart and Vena Cava are placed; in the latter part the Gullet, with the Stomach Nerves. If in this Cavity humors præternaturally assemble and putrifie, they may safely be let out by boreing an hole in the Breast-bone, if we believe *Columbus* and *Hofmannus*, which *Nicolaus Fontanus* doth notwithstanding deny.

It is of a thinner and softer *substance* then the Pleura; and about the Vessels tis frequently full of fat like the Call.

Its substance.

For *Vessels*, it hath *Veins* and *Arteries* from the Dug-vessels and the solitary Vein or *Vena sine Pari*, applied inwardly to the breast-bone, which being taken away they become visible: Also it hath its own proper Vein called *Mediastana*, which is somtimes one and large, other whiles double and smal.

Vessels.

Also the Phrenick and Stomachick Nerves are carryed through this Duplicature, and afford branches to the *Mediastinum*.

The *use of the Mediastinum* is, I. To divide the Chest into two parts, that one Division of the Lungs being hurt by a wound or otherwise, the other might perform its office.

The use of the Mediastinum

II. To hang the Heart and Heart-bag dangling in so free a posture, as to strike against no part of the Chest.

III. To sustaine the Vessels running through the same, as also the Midriff in Mankind, least it should by the weight of the Bowels be drawn too much downwards.

The *Thymus* grows thereto in the *Jugulum* or Throat-pit the higheft part of the Chest, whereunto in ordinary Anatomical Figures it is fastned, and hath its name from the leafe of time which it resembles, not from *Thumos* the Mind, as if in disturbances thereof by passion, the blood and Spirit should work or grow hot within this Kernel, in the *Vena Cava*, as *Riolanus* interprets the meaning of the word; for the blood grows hot in the Heart, here it hath only a passage and tarries not, seeing few branches are discernable in the body of the Thymus, unless somwhat be left by the Arteries for Nutrition sake. In children and the *Embryo* in the Womb, less subject to passions, the Thymus is greater and more Numerous, in persons of ripe years who are soon angry, we find it dried and contracted. Now it is a kernellish, soft, spungy, and white body (some term it the Sweet-bread, be-

The Thymus *what it is?*

The FIGURES Explained.

This TABLE represents the Breſt-bone cut off and lifted up, alſo the Mediaſtinum and the Lungs, with the Midriff.

FIG. I.

AAA. *The inner ſurface of the Breſt-bone and the Griſtles interwoven therein.*
BB. *The Dug-Veins and Arteries deſcending beneath the Breſt-bone.*
C. *The Glandulous Body called* Thymus.
DDDD. *The ſides of the Mediaſtinum pluckt aſunder.*
EE. *The diſtance between the two Membranes of the Mediaſtinum which is cauſed by its forcible ſeparation from the Breſt-bone.*
F. *The Protuberancy of the Mediaſtinum, where the Heart is ſeated.*
GG. *The Lungs.*
HH. *The Midriff.*
I. *Cartilago Enſiformis, the Sword-like Griſtle.*

FIG. II.

A. *The left Nerve of the Midriff.*
B. *The right Nerve thereof.*
C. *The upper Membrane of the Midriff a little ſeparated.*
D. *The naked ſubſtance of the Midriff.*
E. *The Hole for the Gullet to deſcend through.*
F. *The hole or the Vena Cava.*
GGG. *The Membranous part or Centre of the Midriff.*
HHH. *The Portions or Appendices thereof, between which the great Artery deſcends.*

The II. TABLE.

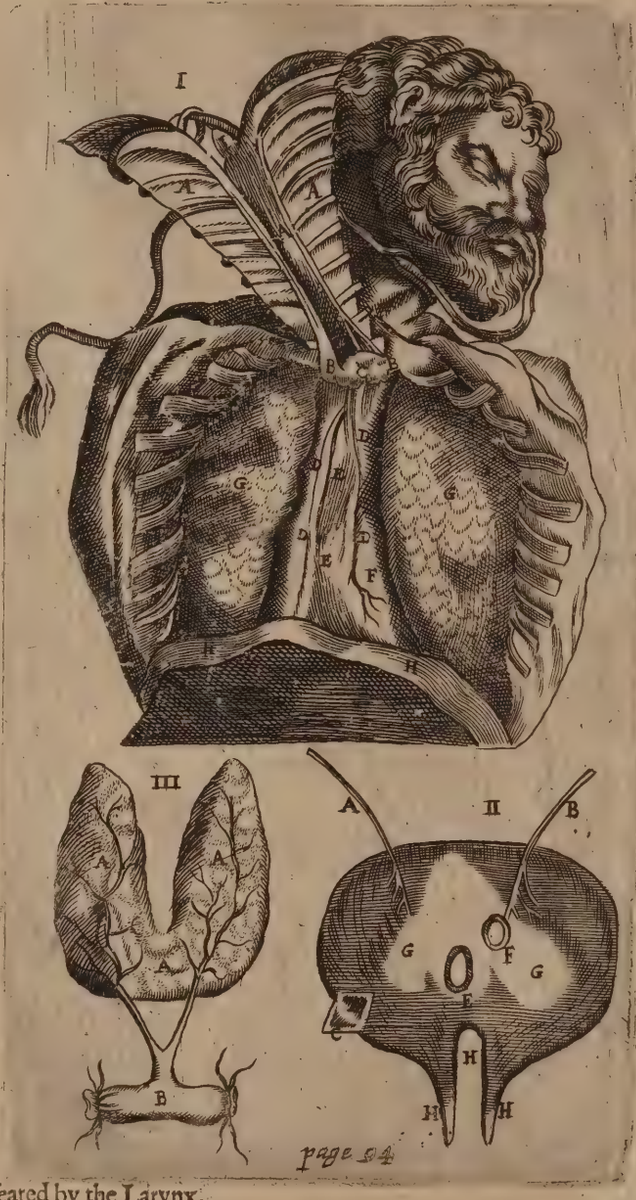

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FIG. III.

Repreſents that ſame Glandulous Body, ſeated by the Larynx.

AAA. *The Glandules or Kernels which naturally breed upon the Larynx.*
B. *A portion of the Jugular Vein, out of which two ſmal twigs proceeding, do ſpread themſelves through the ſubſtance of the Glandules or Kernels.*

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cauſe in a Calfe 'tis counted a dainty bit) In a Child new born tis diſtinguiſhed into a threefold Kernel ſufficiently big. In grown perſons, tis extenuated, its moiſture being conſumed by heat. Howbeit I have ſeen it large in great Sea-fiſh, from which many other Kernels were diffuſed on either hand, about the Mediaſtinum and ſides of the Lungs.

Blood-conveighing *Veſſels* do paſs through this *Thymus* or Sweet-bread; howbeit in the ſubſtance thereof, being diſſected, we cannot manifeſtly diſcerne any.

The *uſe* therefore of the *Thymus* is 1. To underprop thoſe great Veſſels which aſcend that way, as the *Vena Cava*, *Arteria magna*, and their branches paſſing along to the Arms and Shoulder-blades. 2. Alſo for ſafeguard, as is uſual, and that the Veſſels may not be hurt by touching upon the bones. 3. That it may be as it were a cover and fence for the Heart, for I have ſeen it as a Bulwork to the Heart, which the Heart of a Child in the Womb ſtands in need of, becauſe as yet it ſtirs not. And therefore it hath a large Thymus, as a Sturgeon alſo hath and other Creatures which live in the Water, by reaſon of the external cold.

CHAP.

Chap. V. *Of the Heart-bag and the Humor contained therein.*

The Pericardium. *See Tab. 3. of Book 2.*

THe *Pericardium* which some term the Coat, Case, Box, Chamber, Cover of the Heart, or Heart-bag, &c. is a Membrane compassing the whole Heart, whose Figure it therefore Emulates, as also its Magnitude: But it is so far distant from the Heart, as is necessary for the Hearts motion, and the reception of the Liquor contained in this Bag. *Columbus* assures us, that a Scholar of his had no Pericardium.

Its Original. It arises at the Basis from the Coates which compass the Vessels of the Heart, which proceed from the Pleura (for this Coat is not between the Basis of the Heart and the Pericardium) where for their sakes.

Its Hole. It hath five Holes; *viz.* for the ingate and outgate of the *Vena Cava*, and for the letting out of the other three Vessels.

Situation. Its *Situation* is more to the left side then the right; and more to the fore then the hinder part of the Body.

Its Connexion. It is *knit* circularly to the Mediastinum, with very many Fibres, and to the neighbouring parts, but especially the Nevous circle of the Midriff, it cleaves exceeding close, which is a thing peculiar to Mankind: For herein a Man differs from Dogs and Apes, and in all other Creatres likewise, the difference holes.

Its Suface. Its *External Surface* is Fibrous, the *Internal* slippery, and both void of fat.

Its Substance. Its *Substance* is thick and hard, and so much harder then the Lungs, as it is softer then a bone.

Its Vessels. Its *Vessels*. It hath smal *Veins*, below from the Phrenick Vessels, above from the Axillary.

It hath no Arteries that can well be seen; peradventure, because it is so near the Heart. Yet doubtless it hath some although hard to be discerned.

It hath very smal *Nerves*, from the left Recurrent, and the little twigs of the Septum.

Its Use. Its *Use* is I. To be a firme tabernacle for the Heart, that in its motion it might not strike against the hard parts of the Body.

II. To contain a *wheyish* or Watry *Humor*, like Urin to see to, though neither sharpe nor Salt, transparently clear, in some like water, wherein flesh hath been washt; *Guil. Toletus* in *Burgensis* calls it a flegmatick Humor of an unpleasing tast. And because of this Liquor *Galen* resembles the Heart to a Bladder.

Whether all Live-Wights have this wheyish Liquor in their Heart-bags. This Humor is found in all Animals naturally constituted, both living and dead, yea and in the Child in the Womb, as appears by the dissection of bodies both living and dead: But in some more in others less; in persons that are in a Consumption, it is very little and inclining to yellowness. In persons Pleuritick it is now and then of a quittorish nature, according to the Observation of *Salmuth*.

Why more plentiful in dead Bodies. In dead bodies tis more plentyful: Because then very many Spirits are in the cooled parts of the body condensed into water. In Women, Children, and aged persons, tis more plentyful, by reason of the debility of their heat.

If it happen to be in two great a quantity, Palpitation of Heart, and a suffocating death follows therefrom: if it be quite consumed, a Consumption of the body happens. But that it may be bread a fresh when it is spent, we see clearly in those whose Heart-bag being wounded, the said Liquor hath run out; for in *Johannes Saviolus*, his Heart-bag being wounded with a Dagger, water issued at every Pulse of his Heart, out of the wound, yet was he happily cured by the Renowned *Vesingus*.

Whence the liquor in the Heart-bag proceeds? Whence this water should have its original, the opinions of learned men are different.

The first Opinion. I. The first Opinion is of those, who will have it to be sent out of the Vessels of the Heart, seeing Blood-letting cures the Panting of the Heart proceeding from the Super abundance of this Liquor: And they conceive that this wateriſh Liquor is forced out by the fervent heat of the Heart, as in a stick of wood when it burns the sap runs out. Of kin to this is the Opinion of *Nicolas Massa*, which will have it to proceed from the strainings of the blood, which come from the Liver to the Ear of the Heart. And *Hofman* is much of his mind, who maintaines that it is part of that wheyish moisture which ascends to the Heart with the blood; but because the motion thereof is perpetual, there would no smal danger arise, from so large an Afflux of Humors. I let pass, how that the stronger persons, whose blood is moved most swiftly, have less quantity of this Water then those that are weaker.

II. Others, and among them *Hippocrates* seems to make one, will have it to proceed from our drink, some portion whereof they conceive peirces like Dew out of the *Asperia Arteria*, into the *Arteria Venosa*.

III. Some conceive it proceeds from a Watry matter in the Seed, as the inbred Air of the Ears, is thought to proceed from a windy matter in the said seed.

IV. Of kin hereunto is the opinion of *Jasolinus*, who will have it to be a select, most perfect and Elaborate portion of the serous Humor, sent thither by Nature it self, haply in the first formation of the Child, through the Veins and Arteries, besides another part of the drink, of which *Hippocrates* speaks, and he has experiments touching the same.

V. Some say it proceeds from the watry Excrements of the third digestion.

VI. Others from the spittle, slipping out of the Kernels of the Tongue into the Wezand, and from thence into the Arteries and Heart.

VII. Others, from the fat of the Heart, by agitation turned into water.

VIII. Others from the thicker part of the Air which we draw in, being changed into water.

IX. And lastly, some think (which I conceive to be most likely) that it proceeds from moist Vapors and Exhalations, forced out of the Humors of the Heart by the motion and Heat theerof, and thrust forth into the Heart-bag and there congealed into water, in regard of the compactness of the said Heart-bag.

Its Use. Its *Use* is, I. To moisten and cool the Heart, and to facilitate the motion thereof. And therefore those in whom it is consumed, have their Hearts roasted: As it happened to *Casimire* the Marques

Marques of *Brandenburg*: Aud to that young man of *Rome*, mentioned by *Panarolus*. *Hofmannus* being of a contrary mind, will needs have it to be as a Spur and Incitement of Heat; as Smiths are wont to dip their wisps of Straw in Water that they may burn the longer: And as Wood is sprinkled with Water to make it burn more lustily. But those bundles of Straw are preserved by the water, because their substance being made more moist and Tenacious, is not so soon consumed. But the heat of the Heart is preserved by its radical moisture, and by the blood continually flowing in, nor doth it need any Incitement from the Water, for if so, then the Heart would be more hot and lusty in old persons, who have most water in their Heart-bags, II. It serves to make fat by congelation. III. That the Heart by swimming therein, may be less ponderous, and may not strike against any part.

An Humor likewise is commonly found in the *Cavity* of the *Chest*, resembling blood and water mingled together, wherewith the parts of the Chest are smeared, that they may not be overheated nor overdryed. Hence the side of our Saviour being opened, blood and water flowed out, which by the suddan flux, and mixture of blood and the Authorities of the Ancients, I have at large proved, in my Dispute of the side of Christ, against *Laurentius*, *Arias Montanus*, *Bertinus*, *Nancelius*, *Poza*, *Tremellius*, *Beza*, *Tirinus*, *Grotius* and others, who would have it to proceed from his Pericardium or Heart-bag, also against *Collius*, *Tarnovius*, *Brentius*, *Laurenbergius* among the late writers, and *Cyprianus*, *Prudentius*, *Brigitta*, *Vida*, *Sannazarius*, *Vigerius*, *&c.* who would fetch it from the Vessels of the Heart being wounded. Now the Objection of *P. Laurenbergius* is not worth a button, who saies there was not enough of the said Liquor in the Cavity of the Chest; because 1. The natural quantity might suffice, seeing the Evangelists do not record that it come away in a great quantity. 2. It might be augmented in that last conflict for life, notwithstanding the great perfection of his Body, which being for our Redemption made liable to temporary passions, underwent death it self. 3. I have at *Padua* somtimes observed so great a quantity of Water in this part, that it hung down like a great purse, the Midriff being depressed by its weight. *Jasolinus* in wound of the Chest (the inner parts being unhurt) did somtimes collect every day five measures of water called *Heminæ*, for thirty daies together, which the Membranes being inflamed, was dried up and diminished, but when the Inflammation was cured, it returned in its former Quantity.

In a Boy at *Paris*, who died of the small pox, I being present, store of water was found in this part, but of a green colour, of which else-where.

Chap. VI.
Of the Heart in General.

The Heart is called in Latine cor *à currendo* from running, because of its motion; some peradventure will derive it from the Greek name *Kêr* which they derive from *céo* which signifies to burn: the Greeks term it *cardia*, we the *Heart*, quasi *hierôn* a sacred thing. It is the principall part of a living Creature, which none is found to want according to *Aristotle*, and by the hurting whereof the Creaure does for the most part immediately die, because it is the fountain of Life, and labors the vital Spirits, which having made, it distributes, by the Arteries arising from it self, into the whol body. Yet may you find examples in *Schenkius* of those that have had no Hearts. See also *Gellius* book the 16. Chap. 15. *Galen* relates that beasts sacrificed have lowed at the Altar, after their Hearts were taken out; and the Lord *Verulam* tells of a man who spake three or four words of a prayer, when his Heart was pluckt out of his Body, and in the hand of the Executioner. *Plinie* tells us the entrails were twice found without any Heart, when *Cæsar* sacrificed, and *Julius Obsequens* saies the same. The Lives of such persons were maintained by the remainders of arterial Blood. And *Spigelius* suspects that among the Bowells, the Heart was rather hid, and unfound then wanting, who saw so much fat in an Ostrich, that a man might easily have bin deceived, so as to think the Fowl had no Heart. Peradventure those Hearts of the sacrifices were stole away by the Devl.

A Live-wight dies not with every hurt of the Heart. For the Heart undergoes all kind of diseases. 1. *Putrefaction*, witness *Galen*, in a pestilential and aputrid Fever. 2. The *Consumption* according to *Plinie*, to be dried like a roasted warden, according to *Jordanus*, to be wholly consumed by immoderate Heat, as *Tiessius* averr's. 3. *Inflammation*, in which Case it cannot live a natural day, as *Saxonius* found by experience in a certain Reader. 4. *Filthy hollow Ulcers* have bin found therein by *Fernelius*, *Trincavellius*, *Riverius*. 5. Divers kinds of *Tumors*, *Columbus* saw an hard Tume in the left ventricle of a Cardinal, as big as an Egg. *Benevenius* saw a swelling of black flesh. *Massa*, *Valerius*, *Bauhinus*, and *Joubertus*, have other like Stories. I lately found in the Parenchyma of an Oxes Heart on the left side a swelling as big as a Pigeons Egg, in a duble Coat, full of Whey and Flegm.

On the out side *Gesner* saw an Excrescence of flesh. in the Basis the quantity of an ounce and six dams *Bavius* makes mention of the Membrane eate and fretted away round about.

Also Histories shew that it will bear wounds for a season. *Paræus* tells of one wounded in the Heart who ran two hundred paces. *Jacotius* tells of an Hart that carried an old arrow fixed in its Heart, which is confirmed by *Thomas à Vega* and *Alexandrius*. *Galen* saw an Hare wounded in the Heart, run a dartscast after the wound received. Of a Student at *Ingolstadt*, *Sennertus* and *Iohnstonus* tells us, who had both the ventricles of his Heart peirced through with a weapon, and *Nicholas Mullerus* of a Souldier who lived fifteen daies after he had received a wound in his Heart, of which he hung up a Table at *Groeningen*. He recounts many like examples seen by himself, and *Tulpius* tells us of one that lived two daies, being wounded in the right ventricle. *Glandorpius* tells us after *Sanctorius*, that the Heart of a Rabbit was pierced with a sharp Instrument, and yet it lived many months after.

Wee must therefore note 1. That the Heart can endure Diseases, but because it lies far from the way of medicines, it cannot hold out so well as other parts.

2. That, as *Galen* tells us, if the wounds do pierce into the belly thereof, the party or Creature wounded dies, of necessity, but if they be in the Substance thereof, it may live a day and a night, but then Inflammation arising death follows.

3. That the right Ventricle does more easily bear an hurt, because upon the left depends the life of the whol Body.

4. Both Ventricles may endure a small time after they are hurt, if the Vessels that continue the motion of the blood, be undamnified. The

The Heart is one in *Number*. *Theophraſtus* writes, that in *Paphlagonia* Partridges have two Hearts, an example whereof *Galen* relates in a man, in his anatomical adminiſtrations.

Why the Heart is in the middeſt of the Body.

It is *ſituate* in the middle of the body, not conſidering the leggs, as it is in brutes; in which the Heart is in the middle, for moveableneſs and Securities ſake, and in the middle of the Cheſt likewiſe. where it is on all ſides compaſſed with the Lungs. Now the Heart in reſpect of its baſis, is exactly in the middle. that nourſhing blood and ſpirit might more commodiouſly be diſtributed into the whole body.

Howbeit the *Motion* thereof is more diſcernable in the left ſide.

A vulgar Error that the Heart is in the left ſide.

1 Becauſe in its left Ventricle the vital ſpirit is contained, and from thence ariſes the *Arteria magna*, hence the common people imagin that a Mans Heart reſides in his left Side. but Practitioners applie Cordials to the left ſide.

Why the point of the Heart enclines to the left ſide.

2 Becauſe the point of the Heart enclines towards the left ſide, under the left nipple, that it may give way to the Diaphragma: now to the right hand it could not decline, by reaſon of the Vena cava, which aſcends there through the middeſt of the Cheſt. Sometimes the upper part of the Heart enclines to the left ſide, and ſuch perſons are left handed if we beleive *Maſſa*, thoſe whoſe Heart is exactly in the middle, uſe both hands alike.

Who have the greateſt Hearts.

As to its *Magnitude*. In a man proportionably the Heart is greater then in other Creatures, as alſo the brain and Liver. According to the common Courſe of Nature, it equalls ſix fingers breadths in length, and four in breadth. Otherwiſe, the greatneſs of the Heart differs according to the Difference of the Age and Temperament. For perſons cold of Conſtitution, and fearfull have great Hearts, but ſuch as are more hot and confident, have little Hearts: Of which ſee *Donatus*. Hence *Ariſtotle* ſaies of fearfull Creatures, as the Hare, Deer, Mouſe, Hyena, Aſs, Weazel, &c. that they have a great Heart, conſidering the proportion of their bodies. The Philoſophers of *AEgypt*, in ancient times, as appears by *Herodotus* in his Euterpe, have dreamed theſe things of the greatnes of the Heart. That the Heart of ſuch Perſons, as are not waſted by any violent diſeaſe, does every yeer grow two drams heavier, till they become fifty yeers old, ſo that a man of fifty yeers Age, his Heart weighs an hundred drams: but from the fiftyeth year to the hundredth, by a retrograde or back motion, it looſes every yeer two drams, till it vaniſh away, and the party die.

Its *Figure* is conick, becauſe it ends in a point. Its upper part by reaſon of the full veſſels therein, is broad and round, although not exactly, and is called the Root and Head, and Baſis of the Heart: the lower part being ſharper is called *conus*, *mucro*, *vertex*, *cuſpis* and *apex Cordis*; the cone, point, top of the Heart. *Hippocrates* calls it the end and taile. On the foreſide the Heart is more boſſie, on the hinder ſide more flat. In the contractions the whole Heart is longer as ſome hold, but broader and more drawn together according to others; in its Dilatations or Widenings it is greateſt, and of a globous figure, of which I ſhall ſpeak more exactly hereafter.

Connexion.

Its *Connexion* is to the Mediaſtinum and the Midriff by the Pericardium; but to other parts by its Veſſels, they are joyned to the Baſis. the point being free, and hanging dangling like a bell in the Steeple, that it may the more eaſily be drawn back to its Baſis, or moved to the Sides.

Its *Subſtance* is firſt membranous, like a Bladder, in the Child in the Womb, afterward from the mothers blood there grows fleſh or a ſolid, thick and compacted parenchyma.

Why the Subſtance of the Heart is ſo thick.

1. That it might endure the perpetuity of the Motion: for a fence, and that it might more forcibly drive the blood to places far diſtant in the whole Body.

2 Leaſt the ſubtile and lightfull Spirits contained even in the moveable blood ſhould exhale together with the inbred heat.

In the right ſide the wall is leſs thick, becauſe it ſends blood only to the Lungs, which have their venal blood not ſo ſubtile. The ſtrength of the left ſide is greater, by reaſon of ſtronger motion to drive on the blood, to ſupply the neceſſity of the whole body. In the point, the fleſh is thicker and harder not ſo much becauſe it ought not to be moved, as *Riolanus* conceives, as becauſe it is free, contracting the whole Heart in a brief manner, and deſtitute of Veſſels and Ears. In its Baſis, it is not ſo much ſofter as thinner, whoſe Veſſels and Ears do recompence what it wants of firmneſs. Now this fleſh hath all kinds of Fibres, ſo mingled one with another, and ſo compact, that they cannot be eaſily diſcerned; partly for ſtrength, partly for motion. For all theſe Fibres being ſtretched in the Syſtole of the Heart they draw together the Ventricles and the inner ſides, to help the Protryſion or thruſting forward of the blood.

Its Coat.

This ſubſtance is cloathed with a *Coat* hardly ſeparable, for the greater firmneſs, to which it grows in reſpect of the matter, not of the efficient Cauſe.

There is *Fat* about the Paſis of the Heart but hardly about the Cone or ſharpe End thereof, becauſe it is moiſtned by the liquor of the Heart-bag. 1. To anoint the Veins about the Heart. 2. And to moiſten the Heart, that it may not be dryed by motion. 3. To heat the water in the Heart-bag, as the fat of the Kidneys doth, according to the conjecture of *John Daniel Horſtius*. Somtimes it is quite hid with the ſaid fat, which *Spegelius*, *Riolanus*, *Jeſſenius* obſerved in a prince of *Lunæburg*, ſo that the by-ſtanders are apt to be deluded and think there is no Heart.

Whether Fat is found about the Heart?

It was nevertheleſs rightly ſaid by *Ariſtotle*, *Galen* and *Avicenna*. that fat called *Pimele* could not grow about any hot part, as the Heart, the Liver, the Arteries, the Veins, &c. For this kind of Fat is eaſily melted by heat; but in the mean while, to ſteat *Adeps* or Tallow, which differs much from *Pimele* or Greaſie fat, in ſubſtance, conſiſtency and place, as I have demonſtrated in my *Vindiciæ Anatomicæ* from *Pollux*, *Suidas*, *Erotianus* and others, may grow about ſuch parts, becauſe it is not eaſily melted. Which makes a ſputtering when it is put to the flame of a Candle, becauſe of a watry ſubſtance mingled therewith, according to the Obſervation of *Jaſolinus*, which hinders it from ſuddain congealing: ſo that it is no wonder that it is not melted by the heat of the Heart. Now this ſame Tallow is bred about the Heart, either

becauſe the Heart being of a very hard ſubſtance is nouriſhed with thick blood, of which ſuet is bred; or becauſe Excrementitious dregs are bred of the Nutriment of the Heart; or becauſe the blood is much ſtirred, as by the great Agitation of Milk, better is extracted, which is the opinion of *Achillinus*.

The Coronary Vein of the Heart.

As for *Veſſels*. The Heart hath a Vein which is termed *Coronaria* the Crown-vein, becauſe it incircles the Heart, and is ſomtimes double. It ariſes from the Cava, without the right Ventricle, about whoſe Baſis it Expatiates in a large tract from the right Eare, and with a wide Channel it compaſſes about externally to the left Ear, which it doth not enter, but turns aſide into the *Parenchyma* of the Heart. Hence it ſpreads its branches downwards through the ſurface of the Heart, but the greateſt ſtore through the left ſide thereof, becauſe the fleſh is there thicker. A ſmal valve is faſtned in its original, which grants entrance to the blood into the right Ventricle, but will not ſuffer it to go out.

The FIGURE Explained.

This TABLE ſhews the Situation of the Heart in the Body and the going out of certain Veſſels therefrom.

A. *The Heart in its natural Situation encloſed in the Heart-bag.*
BB. *The Lungs.*
CC. *The Nervous part of the Midriff.*
DDD. *The fleſhy portion thereof.*
E. *A portion of the Vena Cava above the Heart, going upwards.*
F. *Part of the ſaid Vein peircing the Midriff.*
G. *The great Artery ariſing out of the Heart.*
HH. *Its branches termed* Carotides, *the Drowſie-Arteries.*
I. *The point of the Heart enclining to the left ſide of the Body.*
KK. *The Nerves of the ſixt Conjugation, from which the recurrent Nerves do ſpring, which diſtribute five branches to the Heart-bag & the Heart.*
L. *The left Ear of the Heart.*
M. *The right Ear.*
N. *The Veſſels of the Heart-bag.*
O. *The* Cartilago Scutiformis, *Sheild-faſhioned Griſtle.*
P. *The firſt pare of the Muſcles of the Larynx in their proper place,*
Q. *The Situation of* Os Hyoides.
R. *The* Aſpera Arteria *or Wezand.*
S. *The Axillary Artery, about the Original whereof, the Right-hand Recurrent Nerve begins.*

The III. TABLE.

As for its Uſe. Some have perſwaded themſelves, that it ſerves to nouriſh the external part, becauſe it is leſſer then ordinary, creeps about the external ſurface only, and the Heart is nouriſhed with Arterial blood. *Others* will have it to nouriſh the whole Heart. *Licetus* aſſignes its Office to ſtrain the blood to the left Ventricle of the Heart, which I wonder at, Becauſe 1. It is exceeding ſmal, 2. It creeps about the External parts. 3. It ariſes externally from the *Vena Cava*, and not from the right Ventricle of the Heart. *Botallus* ſeems to have acknowledged the ſame way, whoſe opinion examined by *Walæus*. Others, as *Riolanus*, make it ſerve not ſo much for Nutrition, as to repaire the fat; but, firſt it reaches farther then the fat. 2. No branches thereof are to be ſeen in the fat. 3. The fat may be generated from

Vapors

Vapors of the Heart, without any Veins. The *true Use* of the *Coronary* Vein is, to bring back the blood of the other Veins, when it returnes from nouriſhing the heart, into the right Ventricle again, which the Situation of the Valves doth hint unto us, and the unfitneſs of this blood to nouriſh the ſolid ſubſtance or *Parenclyma* of the heart.

It hath two Coronary *Arteries* from the great one, at the ſame place, in its original, before it paſſes out of the Pericardium, furniſhed with a Valve which prohibits the regreſs of the Blood. Through theſe, becauſe they are moved and Pulſe, blood is carryed to nouriſh the heart and Ears, and here is made a peculiar kind of *Circulation*, as *Harvy* teaches, out of the left Ventricle into the Arteries, out of them into the Coronary Veins, out of which it ſlides into the right Ventricle, being to be forced again through the Lungs into the left Ventricle.

Now ſome men perſwade themſelves, and eſpecially *Hogelandius*, that the Blood which remains after Nutrition, doth not all paſs back through the Veins, but that ſome particles thereof ſweat through the *Parenchyma* into the Ventricles, and cauſe Fermentation in the Generation of Arterial blood. But 1. The Fermentation, if there be any, may be made by the reliques contained in the Cavities. 2. The coronary Veſſels, do not reach unto the Ventricles. 3. Tis hard when the body is in health, for the blood to ſweat through ſo hard and compact a fleſh, unleſs the blood be very wheyiſh, and the body of a thin Texture. 4. Why doth not the blood ſweat through the Skin, which in ſome parts is very thin? 5. No particle remains in the fleſh, ſave what is ordained for the nouriſhment thereof.

Nerves it hath likewiſe, obſcure ones, from the ſixt conjugation, inſerted into three places: One being terminated into the heart it ſelf: Another into its Ears; A third among its greater Veſſels, to cauſe ſenſe and not motion according to *Piccolhomineus*, becauſe the Nerve being cut aſunder the heart moves nevertheleſs. The heart hath not many Nerves, but a great Contexture of Fibres like to the Nerves, which *Ariſtotle* perhaps reckoning for Nerves, ſaid the heart was the Original of the Nerves. But that may be *Materially* true, not formally. Yet I have ſeen in the heart of a Sow, the branches of the Nerves with intangled twigs towards the *Cone* or Point, carryed from the Septum to the Wall of the Belly.

An Error of Fallopius.

Yet that is falſe which *Fallopius* tells us, that a great Squadron of Nerves is ſpread up and down the Baſis of the heart, reſembling a Net: For the motion of the heart, is no Animal motion, but a natural motion, becauſe the heart is no Muſcle: For the heart is moved without our will, and it bears in the Child in the Womb, before the Child hath received the Animal faculty. And *Galen* did rightly deny that the heart was a Muſcle. 1. Becauſe it hath all kind of Fibres. 2. Becauſe a Muſcle is the Inſtrument of voluntary motion. But if any one ſhall ſay the heart is a Muſcle ſubſervient to natural motion, I ſhall oppoſe ſuch an improper manner of ſpeaking: And ſo that of *Hippocrates* may be true, that the heart is a muſcle. For he defines a Muſcle to be fleſh made up into an Orbicular ſhape. *Others* conceive that being long boyled it reſembles a Muſcle, and that then it is not one, but divers Muſcles, by reaſon of divers motions contracted into themſelves.

Whether the Heart be a Muſcle?

Others grant it to be a Muſcle of a nature by it ſelf, as the Midriff, which is perpetually moved. *Walæus* moſt rightly of all others calls it not a Muſcle, but ſaies it is contracted in its motion like a Muſcle, by Fibres interwoven in the fleſh, and eſpecially in the Ventricles, like the temporal Muſcle in ſuch as chew their meat.

The Error of Averroes.

The *Temperament* of the heart in reſpect of active Qualities is hot, yea the hotteſt of al the parts of the Body. How beit with a gentle and light-ful heat, not ſcorching and burning, if it be rightly diſpoſed. And therefore tis no wonder, that in live diſſections, ſomtimes we feel ſo little heat in the heart with our Finger, eſpecially when our Skin is thick, we hold it but a little while, and the external Air is not rightly prepared before hand. It communicates the ſame heat to other parts, and renders ths Arterial blood fit to nouriſh, which heat being aſſwaged in the Veins by reaſon of the long jorney, it muſt of neceſſity run back again to the heart, that it may be refurniſhed and reſtored with the ſame heat. But vain is the opinion of *Averroes*, that the heart is cold, becauſe of the cold parts which it contains, *viz.* its Veſſels and Valves: Unleſs haply he ment the heart void of Spirit, as many will have it.

An Hairy Breaſt what it ſignifies?

Thoſe whoſe heart is hotter then ordinary have their Breaſt rough with hair, and the parts near their Hypochondria; and thoſe men are angryly inclind, and daring.

An Hairy Heart what it ſignifies?

Seldom is the heat of the heart ſo great, as that it ſelf ſhould thereby become rough with hair, ſuch as *Pliny* and *Valerius Maximus* tell us was found in *Ariſtomenes* a Micenian; and in *Hermogeneſs* a Græcian, *Cælius Rodiginus* relates: and *Benevenius*, *Zacutus Luſitanus* and *Muvelus* avouch that they ſaw ſuch hairy heart in certain Famous Theives. Now ſuch Men are audacious in the higheſt degree, extream hot and crafty, and for the moſt part wicked. *Riolanus* tells us, that the matter of theſe haires, is the thick ſettlings of that wheyiſh humor which is in the Heart-bag. But I am more apt to beleive, that it is the plenty of Fuliginous Excrements ſpringing from an hot heart.

As to the paſſive Quallities, the Heart is moiſt, viz. more moiſt then the Skin, but drier then the Muſcles, becauſe harder: for the parts of the bodie, look how much ſofter they are then the Skin, by ſo much are they moiſter then it. It is a moſt rare Caſe for a mans Heart to be ſo ſolid, denſe and compact, as that it will not burn, ſuch as was the Heart of *Germanicus* the ſon of *Druſus*; or cartilaginous, ſuch as *Riolanus* obſerved in a wicked fellow.

The primary *Uſe* of the Heart.

1. According to *Harvey*, *Bacciur*, and other of his followers, is no other then to be the Inſtrument of the Soul, to force and urge the venal blood received from the Ears into the Arteries, by whoſe aſſiſtance it diſpenſes Nutriment to the whole body, and is rather joyned as an Aſſiſtant to the Ears, that being of greater force, it may ſupply the defect of the Ears.

But this is a ſecondary uſe of the Heart. For 1. Nutriment was to be prepar'd & filled with vital heat, which it has not elſe where ſave from the heart. 2. Nature might have provided for this paſſage of the blood, by ſome other member not ſo laboriouſly framed, 3. The neceſſity of the Heart would not be ſo great as it is. 4. It is a ſigne that ſome farther thing is performed in the

the Heart, in that venal blood does not nouriſh, before it enters the Heart.

Now the primary action of the Heart is to be.

II. The *Fountain* of *Heat*, whence it is ſpred into the whole body, whereby the parts are animated and ſuſtained. Swooneing teaches ſo much and other defects of the Heart, in which the heat of the Heart being intercepted, the Members of the Body begin to flag and being deſtitute of heat, become ſtupid. And therefore cordials do good in ſuch caſes, which ſtir up the languiſhing and nummed heat of the Heart. Alſo the Diſſection of living Creatures does ſhew, that the Heart is hot, yea that the heart of a Creature being taken out and newly dead, a warm finger, or ſome other warm thing being laid upon it, is ſeen to come to its ſelf again and to ſtir, which the Lord *Bacon Conſtantine*, *Harvey*, and others have obſerved in a Dove, an Eele, a Salmon, and a Man.

It is therefore the Fountain of Heat, both in reſpect of its *Subſtance* and of the *Blood* contained in it. I joyn both together. For the Heat ſprings not from the blood alone, as *Harvey* would have it, for the Heart in an Egg, and a Child in the Womb, before it is perfect and hollowed with ventricles, is hot and moves, and the ſame heat remains in Hearts taken out of the Body and cut up. The blood which flows thither from the Coronary Veſſels, flowes thither for Nutritions ſake and to preſerve the Heat. Nor are the reſt of the ſanguine parts, therefore judged to be hotter then other parts becauſe they more abound with any heat, but becauſe they have Arteries full of arterial blood, and depend upon the influence of the heart, wherewith the blood is heated. So that unleſs all the blood did paſs through the heart, the parts would never grow hot, and the further the blood goes from the heart, by ſo much the ſloer in its motion, and the colder it growes. That the coldneſs of the heart makes the parts of the Bodie cold, though full of blood, the ſlowneſs of the Pulſe is a ſign.

Nor do the Blood and Heart grow hot only from the motion of the Heart, as the followers of *Des Cartes* wil have it, for 1. they grant that the fiery atomes or indiviſible particles of fire, are excited and put into action by motion, though they are only brought into play, but not produced by the ſaid motion. 2. Many things are moved without waxeing hot, as water, unleſs they have an inbred principle of heat. 3. Before motion there was heat proceeding from the ſeminary original, which is afterwards *preſerved* by continual motion.

III. Not ſo much to make as to perfect the Blood.

Whether the Heart doe perfect the Blood.

It makes Arterial Blood, and perfects the venal, or that which is contained in the Veins. For they are out who attribute too much to the heart, as if the heart alone did make blood of the Chylus, they alſo are miſtaken, who maintaine that the heart contributes nothing to blood-makeing. I goe in a middle way. The Liver challenges the firſt makeing of the blood of the Chylus, as I have formerly demonſtrated, which becauſe it is not there perfected, being to thick and unfit to nouriſh, it is neceſſary that it ſhould receive its perfection from other parts. No part is fit for this work ſave the heart, which is one of the firſt parts generated in the Womb, and through which in a grown perſon all the blood in the body has its paſſage. That the Lungs and heart-ears ſhould perform their Office, no man will beleive.

The heart perfects *two ſorts* of *Blood*, *that of the Liver* and *that of the Veins*. That of the Liver is twofold, the one of the Vena portæ, the other a cruder ſort newly made of Chyle. The *Vein* blood is likewiſe twofold, one of the deſcendent trunk of vena cava, and the other of the aſcendent trunk of the ſaid vein. It receivs the Liver blood through the Cava, to which another joyns it ſelf out of the lower and upper Truuk, which remaining over and above after the parts are nouriſhed, by its long journey is become pauled and ſluggiſh, and has loſt its heat, which is neceſſary for pulſation and nutrition.

This perfection which the Blood receivs from the heart, is hereby confirmed, in that the blood when it comes out of the left Ventricle, has not altogether the ſame Conſiſtence nor Colour, which it had when it entred the right Ventricle. The diverſity conſiſts in *Heat* and plenty of *Spirits*, wherewith it is furniſhed when it goes out of the heart, and which it wants when it enters thereinto; and in *Effect* or *Operation*, for that which goes out is fit to nouriſh, but that which enters in is moſt unfit, Vital Spirits are added by the inbred faculty of the heart, and the ſooty vapors are taken away by that moſt ſhort Concoction, being evacuated by the Lungs and Pericardium or heart-bag.

For what parts does the heart perfect and renew the blood.

The *ancients* did beleive that the Heart made blood only to nouriſh the *Lungs*. But the Veſſels of the lungs are greater then is requiſite only for their Nutrition, and there is continually more blood forced thither by the pulſation of the right Ventricle, then could any waies be uſeful for the Lungs, unleſs they were to be nouriſhed with as much blood as is ſufficient for the whole Bodie. And that all is not conſumed upon the ſubſtance of the Lungs, the blood which returnes is a witneſs, which runs in great plenty at every pulſation, to the left Vetricle, through the Arteria venoſa, which in live anatomies being tied, is ſeen to ſwell betwixt the ligature and the Lungs. For there is no way for it to return into the right Ventricle, the paſſage being ſtopped by the cloſe ſhutting of the mitre-faſhioned Valves.

The right Ventricle therefore is buſied about blood which is to be ſent to nouriſh the Lungs; the left doth perfect the blood which flows back from the Lungs, being there imprægnated with air, for the Nutrition of the whole Bodie. For the arterial blood alone is that which nouriſhes, becauſe it is only fit for nutrition, and it alone is forced through the Arteries into the utmoſt parts of the Bodie.

What things are requiſite to perfect the Blood?

To perfect this blood many things concur. 1. *Heat*, which is very dull and laſie, as well in the crude blood of the Liver, as in the returning blood of the whole Body. 2. *Vital Spirit* which by the confeſſion of all men, ought to be joyned therewith, 3. *Light* the companion of the Spirits, by which the blood receives a more Illuſtrious color, is moved and made fit for Nutrition. 4. A certain light and momentary Concoction, ſweetning the cruder parts, attenuating the whole ſubſtance, and drawing forth the latent flame. 5. The whole *Fabrick* of the heart, internal and external, and the Veſſels both receiving and expelling. 6. The ſeparation of Excrements, though the receptacles of the ſaid Excrements are not very manifeſt. The *ſooty Vapors* of the right Ventricle do evaporate through the *Vena Arterioſa*. The *Watry Vapors* of both the Ventricles, are congealed into the water of the Heart-bag, and are ſpent into the ſubſtance of the Hairs under the Arms. The *remaining Excrements* continue mixed with the Blood, and are carryed into the Arteries, and the wheyiſh parts are purged by the emulgent Arteries into the Kidneys,

Kidneys, and by ſweats into the habit of the Body, the thicker parts by the Hemorrhoidal Arteries and the Ramus Meſentericus. Some parts return with the blood through the Veins into the Heart, that by ſeveral repeated courſes there, they may be at laſt maſtered and overcome.

In which Ventricle the Blood is perfected.

Whether or no is the Blood equally perfected in the right and left Ventricle?

Although the heat of both the Ventricles doth ſeem to be equal, becauſe in Mankind they are both made of ſpiritful ſeed, and as much is afforded to the right Ventricle by the Liver-blood, and the returning blood of the Veins, as to the left by the Lungs; moreover in Live Anatomies we can hardly perceive that the one is hotter then the other.

Yet that in the left the blood receives greater perfection, theſe ſigns and tokens do perſwade me; becauſe

1. It receives the Blood in ſome meaſure prepared from the Lungs.

2. It ought to perfect it for the whole Body, whereas the right perfects it only for the Lungs.

3. It hath thicker Walls, more compacted fleſhy Pillars, wherewith the heat is both more eaſily preſerved and reverberated, and the blood more ſtrongly driven.

4. The blood is therein more frequently clottered by heat, and Cartilaginous and boney ſubſtances appear being dryed by heat.

5. When the left Ventricle is hurt, there is greater danger of death, then when the right is hurt.

6. Many Live-wights want the right Ventricle.

7. In dying perſons it is ſooner dead and void of motion then the right.

8. The Cavity thereof is more narrow, and therefore it doth more eaſily preſerve and perfect that which is contained therein.

We cannot exactly define *the place*. It is the whole Cavity, endued with the virtue of the Parenchyma, becauſe the blood fils the whole in the Diaſtole, and the inbred ſpirit, is every where diffuſed. Nor is there any token, of any ſtay which the whole blood makes in one place more then another, nor of any peculiar virtue of any particle.

The *Time*. It is perfected in a Moment, becauſe

1. It is forthwith received and expelled, and makes no tarriance.

2. From its abidance there, the blood would not be perfected but become aduſt.

3. The flame on the Candle ſnuf, lights another Candle in the twinckling of an Eye.

4. The Arterial Blood doth continually run to the extremities of the Body, and therefore it ought to be continually and ſuddenly perfected in the Heart.

IV. A fourth uſe of the Heart is perpetually to move. 1. That it might preſerve the Blood and all parts of the Body from putrefaction. 2. That it may help the heat and Elaboration of the Blood. 3. That it might kindle and ſtir up the vital Light. 4. That it might ſend fitting nouriſhment to all parts.

What the Pulſe is.

This motion of the Heart is termed PULSUS the PULSE, which is continual without ceaſing, raiſed by the influent Blood, and the Pulſifick or Pulſative faculty, there reſident.

Its Parts.

It conſiſts of a *Syſtole*, *Diaſtole* and *Peri-ſyſtole*. Which muſt be diligently explained by all their cauſes, according as Ocular Inſpection of living Bodies and reaſon ſhall Dictate.

Syſtole, being the proper and natural motion of the heart, is a contraction and drawing of the heart into a narrow compaſs, that the blood may by that means be forced out of the right Ventricle through the Vena Arterialis, into the Lungs, and out of the left Ventricle through the Aorta into the whole Body.

Diaſtole, being an accidental motion, is the widning of the heart, that Blood may be drawn in through the Vena Cava into the right Ventricle, and through the Arteria venoſa into the left,

Peri-ſyſtole is a certain reſt and ſtop going between both motions, when the Blood is about to enter into or go out of the Ventricles, ſo ſmal in healthy perſons that it cannot be diſcerned, being very manifeſt in ſuch as are at the point of death. It is only one between the Syſtole and Diaſtole, or between the Diaſtole and Syſtole. This is the natural ſtate of the heart.

Beſides theſe motions two others are Obſerved.

1. A certain Undation or waving towards one ſide according to the carriage of the right Ventricle, as if it did gently wreath it ſelf, as we ſee in an horſe when he is drinking; of which *Harvey* ſpeaks. 2. A *trembling* motion of the Heart, when it is cut in ſunder. The former depends upon the Situation of the right Ventricle: The latter is preternatural to the heart, not ariſing from other particles or ſmal Bodies, ſent in by the Coronaria, which is then cut in ſunder, but from the remainders of the vital Spirits.

The Heart takes in Blood in the Diaſtole.

We are taught by the teſtimony of our Eyes, that in every *Diaſtole* blood is plentifully received in, and in every *Syſtole* plentyfully expelled, both into the Vena Arterioſa and the Aorta. This appears I ſay to our Eye-ſight.

1. By Ligatures or bindings in live Anatomies. If the *Cava* and the *Aorta* with the Veſſels of the Lungs ſhall be bound or preſſed down with the Finger or any other Inſtrument on either ſide; we ſhall manifeſtly perceive that the part of the *Cava* which is inſerted into the Heart is made empty; that in the *Diaſtole* of the Ear, it is filled, and thereby the Heart; and that the other part of the Aſcendent and Deſcendent Vein, on this ſide the Ligature, doth ſwel. In like manner, the *Arteria Venoſa* being tied near the heart, by the *Diaſtole* of the left Ear, it is made void and empty on this ſide the Ligature where it looks towards the heart, but towards the Lungs it ariſes and ſwels. The Arterial Veſſels of the heart, do ſhew themſelves in a contrary faſhion: For the *Vena Arterioſa* being tied, it ſwels towards the heart, becauſe it is filled by the *Syſtole* of the right Ventricle; the *Arteria Magna* being bound, ſwels between the heart and the Ligature, being filled by the *Syſtole* of the left Ventricle.

2. Beſides the Ligatures, we may gather as much from the veſſels being opened or wounded. The *Vena Arterioſa* and the *Aorta Arteria* being opned by a Lancet, at every *Syſtole* or Elevation and Contraction of the heart, it pours forth plenty of blood, as long as the heart continues ſtrong, for when it languiſhes, it intermits ſome Pulſes, before it voids any Blood. Now we obſerve no ſuch thing, when the *Cava* or *Arteria Venoſa*, are opened between the heart and the Ligature.

3. The point of a living Heart being cut off, or the heart being cut aſunder through the middle, in every Contraction blood iſſues out, as long as the heart remains vigorous, which by the Information

The FIGURES Explained.

This TABLE doth in some measure express the Systole of the Heart in a Living-Creature, and the Circulation of the Blood.

FIG. I.

AA. *The Lungs drawn back.*
B. *The Aorta Artery bound, and swelling towards the Heart.*
C. *An Orifice made in the swoln part.*
D. *The Vena Arteriosa tied, in like manner swelling towards the Heart, growing yellow where it looks towards the Lungs.*
e e. *The Ears on both sides.*
FF. *The Fore-side of the Heart, being in the Systole somwhat hard, and bent, and with its sides extended, its point being drawn back to the Basis or broad End.*
gg. *The Coronary Vessels.*

FIG. II.

Shews the form of the Heart in its Diastole, and the motion of Humors in its vessels.

a a. *The Arteria Venosa without binding, being ful towards the Lungs, empty towards the Heart.*
b. *The left Ear, which receives blood from the Arteria Venosa.*
C. *The Vena Cava tied, empty towards the Heart, ful towards the Liver.*
d. *The right Ear swoln or heaving.*
E. *The hinder-side of the Heart, as it is in its Diastole, flagging.*
ff. *The hinder part of the Lungs, which are bunching or Bossie.*

FIG. III. and IV.

Represents the Inside of the Earlets or little Ears of the heart. The third Figure Represents the left Earlet; The fourth, shews the Right

aaa. 3. 4. *The Plane Membrane of the Earlet.*

The IV. TABLE.

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b. 3. *The Orifice of Arteria venosa.* 4. *The Orifice of Vena Cava.*
cccc. 3. *The three-pointed Valves with seven Fibres, in* 4. *the same with five only.*
ddd. *The larger fleshy Pillars.*
eeee. *The lesser fleshy Pillars, Interwoven one within another with wonderful artifice.*
fff. *Many-fold Cavities formed between the Pillars.*

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of *Harvey*, I have often seen in the Dissections of *Walæus*.

4. The swelling of the Heart and the Flagging thereof, being Palpable and visible to the external sense, do sufficiently demonstrate, when it is made strait in the Systole, that of necessity somwhat must be squeezed out as it were forcibly, and that when it is widened in the Diastole, it must needs be filled with humors.

5. The Ventricles in the Diastole appear greater, and in the Systole lesser.

6. From the largness of the Vessels of the Heart: the *Vena Cava* and *Arteria Venosa*, do open into the heart with wider mouths, then to suffer only a final quantity of blood to enter. Also the Arterial vein and the *Aorta* are larger, then to send forth nothing, or only Spirits.

The Quantity of blood in the Heart.

The Quantity of Blood which fills the Heart in the Diastole, and which goes out by the Systole at every pulsation, cannot be exactly measured, because it varies according to the different state of the heart,

heart, and the temper of Animals, their Age, Sex, course of Diet and Life, &c. It is apparent to our Eyes in live Anatomies, that much is received and expelled. But it moves not in and out in so great quantities in persons that are well in health, when the Heart is more quiet and hath the command of it self. The Antients supposed that a drop or two was enough at a time, and that the blood did freely pass and repass the same way. But one drop of blood unaltered, is not able to fill the heart, nor doth provoke it to pulsation, not to speak how the foresaid experiments do shew the plenty that passes to and fro. Now the Valves do hinder the free passage and repassage of the blood by the same waies, of which the three pointed ones or *Tricuspides* so called, do hinder the blood which enters the heart from passing back the same way, and the Mitre-shap'd Valves do hinder the blood which goes out of the heart from returning the same way.

Later Physitians, are divided in their opinions. Some suppose that a drop or two is either so rarified as to fill the heart, amongst whom is *Des Cartes*; or is turned into spirit, as *Riolanu's Primrose*, *Leichner* and others suppose, who measure it by grains, whom we shall answer when we come to the *Causes*: Others being Patrons and favourers of the circular motion of the blood, as *Harvey*, *Walæus*, *Conringius*, *Slegelius*, &c. do calculate the quantity, by ounces, drams and scruples.

To clear up this Question, three things are to be considered, 1. How much blood is contained in the Diastole of the heart. 2. How much is expelled or driven out of the heart, in its Systole; whether all that enters the Heart in its Diastole, is squirted out in the next Systole. 3. How many pulsations the heart makes in one hour; or how often the heart receives somwhat by its Diastole, and expels somwhat by its Systole, in the space of an hour.

1. In the heart being in its *Diastole*, *Harvey* hath found above two ounces of blood. Also *Plempius* found near upon two ounces of blood, in the left Ventricle of the heart of a man that was hanged. *Riolanus* will hardly allow half an ounce in the left Ventricle of one that was hanged, and saies there was more blood in the right Ventricle. *Hogeland* also wil have half an ounce or a dram at least, to enter, at every opening of the Ear.

Now the quantity of all the blood contained in the body, doth seldom exceed twenty four pounds, or come short of fifteen.

2. In the *Systole* there is expelled either a fourth part, or a fift, or a sixt, or at least an eight, or all together that is contained in the heart.

Harvey supposes half an ounce in a man, or three drams, or one dram, in a Sheep and a Dog he saies a scruple. And he proves the same by that suddain effusion of all the blood, if the very least Artery be cut, and because in the space of one half hour, all the blood may be passed through the heart, he certainly concludes, that in every Systole of the heart, much blood is expelled. *Conringius* approves of his Computation. *Walæus* admits of half an ounce, but he supposes only one scruple, as doth *Slegelius*. *Regius* has many times observed half an ounce, sometimes two or three drams, in the heart of a Dog dissected. *Hogeland* contents himself with a dram. I being more sparing suppose half a scruple, in the smallest proportion to the quantity which issues in such as are wounded. For there goes not out so much in an healthy free heart, as in one that is bound and forced; nor is there so much expelled in the following Systole, as was drawn in by the Diastole, some part sticks in the hollow pits of the heart, much staies in the Cavity formed by the production of the three pointed Valves and Distinct as it were from the Ventricle; finally, the heart cannot be so straitly contracted in the Systole, as to squeeze out every jot of the Blood therein contained. Therefore *Conringius* doth rightly suspect that abides there the space of one or two Pulses, till by little and little it raise it self, which I understand of the reliques and part of the Blood, not of the whole received by the foregoing Diastole.

3. *Primrose* numbred in one hour 700 pulsations of the Heart. *Riolanus* 2000. *Walæus* and *Regius* 3000, *Harvey*, 2000. in some 4000, 6000, 8000. *Cardan* 4000. *Plempius* 4450. *Slegelius* 4876. I have told upon mine own wrist about 4400, But the number varies according to the Age, Temperament, Diet &c. of every person. So many Systoles therefore and so many Diastoles there will be in one hour, as long as the Heart is vigorous, for a languishing heart has more Diastoles then Systoles.

From these three Præmises I have calculated, how much blood may in an hour be squirted out of the Heart, by its sundry pulsations.

From 1 scruple 3000		161. 5 ounces.
1 scruple 4000		131. 10 oun. 5 dr. 1 scr.
1 scruple 4450	times	151. 5 oun. 3 dr. 1 scr.
half a scruple 4400	re-	71. 7 oun. 5 drās, 1 scr
1 dram 2000	peat-	201. 10 ounces.
2 drams 2000	ed, a-	411. 8 ounces.
half an ounce 2000	rise.	831. 4 ounces.
1 ounce 2000		1661. 8 ounces.

Now supposeing all the blood contained in a mans body to be fifteen pounds, if that be taken away which goeth into the Nutriment of the parts, the defect whereof is suplied by new blood bred in the Liver, it will follow,

1 That more blood passes through the Heart every hour, then can be afforded by the Concoction of the Liver and the Stomach.

2 That all the Blood in the Body passeth through the Heart, in the space of a quarter of an hour, or half an hour, or an hour, or an hour and an half, or two houres at the most. For I cannot agree to *Riolanus* his conceit, that the blood is circulated only once or twice in a day, because he builds upon a false supposition of drops, and that only half the blood is circulated.

3 That the parts to be nourished do not need so much blood for their nourishment.

4 Because neither the Vessels are broken, nor the Arterial blood can run back again because of the valves nor is elsewhere dissipated, of necessity it runs back through the Veins into the Heart, and the Circulation is performed, of which I shall speak more in my book of Veins and Arteries.

The form of the Heart in the Systole.

What the form of the Heart is in its Systole and Diastole, is known by three tokens. 1 By the Anatomy of living Creatures 2 By the Comodity and Convenience of motion and Rest. 3. By the carriage of the fibres and the situation of the parts.

In the *Systole* 1 The Point of the Heart draws up to the basis or broad end, and it becomes broader because it is busied in expelling the blood, the length thereof being changed into breadth, because the basis or broad end is immoveable in respect of the point, which

which is tied to no Veſſels. But according to the obſervation of *Walæus* in thoſe living Creatures, whoſe *Aorta Arteria* does not proceed from the Baſis, the broad end or baſis of the Heart withdraws it ſelf from the Point. *Riolanus* will have the Baſis of the Heart alwaies to draw towards the Cone or Point thereof, becauſe the ſaid Cone is harder then to be drawn or bended backwards. But elſe where, he denies that the Baſis being ſtrongly faſtened to the veſſels, can be drawn towards the Point. And therefore other, whom *he* and *Slegelius* do follow, conceive that it is extended long-waies, that its walls being contracted, it may expel the Blood. But then the Orifices of the Veſſels being drawn downwards in the lengthening of the Heart, would be ſhut, and a contrary motion would happen; beſides that living Anatomies do ſhew, that the heart becomes ſhorter in its Syſtole. Nor can it appear longer but ſhorter, if either the point draws to the Baſis or the Baſis to the point. Both forms ſerve for expulſion of the blood, for whether you preſs a bladder ful of water longwaies or broadwaies, you will ſqueeze out the water as ſoon one way as another.

2. The inner walls are on each ſide, drawn up to themſelves towards the Ribs, becauſe they are contracted and ſtraitned, as we find by putting our Finger in: But the outer parts being ſwelled, ſeem to be made broader, by reaſon of the contraction of all the parts, blown up in the diſtenſion. It differs therefore from *Galens* Syſtole, which *Leichnerus* will have to be drawn likewiſe into it ſelf, the Longitude of the Heart being changed into Latitude. For indeed and in truth the Diaſtole is, when the heart is made wider, either long-waies or broad-waies, to the intent that it may be filled, unleſs the inner parts be ſtraitned.

3. The foreſide of the heart is lift up towards the Breaſt-bone, eſpecially obout the Baſis. For the Broad end or Baſis of the heart, ſmites the Breaſt where the Pulſe is felt, becauſe that part is raiſed, and neareſt the Breaſt-bone; in the Syſtole the Heart is, vigorated and mettleſome, not in the Diaſtole, and then the Arteries are dilated and filled, whereas the heart is emptied in the Syſtole, and at the ſame time the Pulſe is felt, in the Wriſt and the Breaſt, at one and the ſame time. But the Pulſe is moſt of all diſcerned, in the left ſide of the Breaſt; becauſe there is the Oriſice of the Arteria Aorta.

4. The whole heart becomes every where tight and hard.

5. It is more contracted and ſtraiter then within, and leſs in bulke, which we judg by our ſight and feeling.

6. It appears white, eſpecially in the more imperfect ſort of Animals, by reaſon of the voidance of blood in its Syſtole.

In the *Periſyſtole*, when the heart is looſe and ſoft, before the *Diaſtole* follows, and the heart is in its properſtate.

1. The point withdraws it ſelf from the Baſis, and the Baſis from the point in ſome perſons.

2. The lateral parts internal and external do extend themſelves towards the Ribs.

3. The foreſide falls in, the hinder part is depreſſed, eſpecially above at the Orifice of the Aorta, according to the accurate Obſervation of *Walæus*.

The other *Periſyſtole* which goes before the Syſtole, is hardly by any notes diſcernable from the *Diaſtole*.

The ſhape of the Heart in the Diaſtole.

In the *Diaſtole*, which *Backius* tells us begins in the middle way to Dilatation, and ends in the middle way to contraction,

1. The upper ſide is lifted up and ſwolne by blood flowing in on either hand by the Venal Veſſels, the ſwelling proceeding by little & little to the point. But it doth not then ſmite the Breaſt, as *Laurentius* and *Roſſetus* would have it, becauſe the Arteries undergo the Syſtole, and the heart ceaſes from expulſion, for which cauſe it is not Vigorated.

2. It is more flagging and ſofter, becauſe it ſuffers in its reception of blood.

3. The ſides remain more lank and extended, and the Cavities remain wider, and therefore when a man puts his Finger into a living heart, he feels no conſtriction.

4. It is red, becauſe of the thinneſs of the walls, and the Blood received in, which is Tranſparent.

5. The Cone departing from the Baſis in the Periſyſtole, renders the heart more long, that it may be more capacious to receive the blood. That it is drawn back towards the Cone, as many write, our Eye-ſight will not allow us to believe, nor can it or ought it ſo to be. It cannot becauſe the Fibres are relaxed and not bent; nor ought it, becauſe it muſt be enlarged to receive, which you may in vain expect, the Ventricles being ſtraitned and revelled. Nor do I aſſent to *Des Cartes* and *Regius* men of moſt ſubtile wits, that in the Diaſtole the point draws near to the Baſis, in the Syſtole it departs therefrom; for they confound the Periſyſtole or quiet poſture of the heart, in which the heart is ſoft, looſe and void of blood, before the Diaſtole is performed, after the Syſtole is ended. Moreover, *Walæus* believes, that thoſe men were deceived, who in a wounded living heart, pretend to have ſeen blood expelled in the Diaſtole; becauſe they took that to be the Dilatation, which was indeed and in truth the contraction. The blood which goes out of the wound, goes out in the Diaſtole, not driven by the Pulſe, but becauſe the way lies open downwards, it gently ſlides out, drop by drop.

The next Efficient Cauſe of the motion of the Heart.

The *Efficient* Cauſe of the motion of the heart, is either immediate or remote. The *Immediate* is twofold, the *Blood* and the *Pulſifick* faculty. *Pulſifick* or *Pulſative faculty.*

The *Blood* either remains in the ſame quantity as it flowed in, or it is changed in quantity by boiling, working and rarifying.

1. *Pure* blood and ſincere, flowing in through the Vena Cava and Arteria Venoſa, and remaining ſuch, only becoming more perfect and vital, raiſes the heart into a Tumor like water in a Bladder or Skin-bottle, which being for the greateſt part diſtended, becauſe the plenty of blood is burthenſome, it raiſes its ſelf to expel the ſame, by gathering together its Fibres; and this motion happens to the heart in this caſe, as the motions of other Members, *viz*, the ſtomach, Guts, Bladder, Womb, which are extended by the reception of Chylus, Whey, Wine, Blood, &c. which being expelled they fall again; and like the Muſcles, which are ſtretched being ſwoln with Animal Spirits. By this Blood the Heart is continually moved, as a Mill-wheele is by the perpetual falling down of the Water, which ceaſing the Wheel ſtands ſtill. There is plenty of blood enough to diſtend it, not ſo much furniſhed from the Liver, as from the aſcendent and deſcendent branches of the Cava, running

ning back from the remoteſt Veinulets or ſmalleſt branches of the Veins, and it is continually forced along, with Celerity and Vehemency, according to the Demonſtrations and Doctrine of *Harvey* and *Walæus*. I ſhall juſtifie what I now ſay with only one experiment: If the Veſſels which bring into the heart be tied and ſo ſtopt, the Hearts motion ceaſes, and there remains nothing but a Wavering and a Palpitation; but the Ligature being looſned, it recovers its motion.

Ariſtotle makes the Cauſe to be Blood which is not pure, nor in ſo great quantity as to be able of it ſelf to diſtend the Heart, but boyling and working, which boyling of the blood many have followed, though explained after a different manner. *Cæſar Cremoninus* makes the cauſe to be the reſiſtency of the Heart, and the ſwelling thereof by reaſon of the Ebullition, which afterward falls, by reaſon of the inbred heavyneſs of the heart, as parts puft up with wind, do of their own accord ſettle when the wind is out, and the heaving of the Earth cauſed by repletion and blowing up of wind, ſettles again, by the peculiar heavyneſs of the Earth. *Caſpar Hofman* flies to the inæquality of the boyling blood, which is like boyling water, part whereof aſcends and part deſcends.

Others do interpret the matter with greater ſubtilty ſaying that the blood is changed into an Airie ſpirit. *Primeroſe* ſaies, that blood juſt as Milk, Honey, and very many things beſides, doth exceeding ſwel and riſe, ſo as to become nothing but a kind of Spirit or light Air. *Leichnerus* ſaith that of one grain of good blood a great quantity of Cordial Balſam is made: even as by one grain of Odoriferous Gum caſt upon a Cole, an whole Chamber is filled with a delitious ſmel.

But many difficulties ſtand in the way of this Opinion.

1. No boyling is of it ſelf equal, but the Pulſe is ſomtimes equal.

2. The Pulſe ſhould be greater according as the Boyling is greater. But the boyling of the blood is greateſt in burning Fevers, by reaſon of the extremity of bubbling heat and the various nature of the Blood, yet is the Pulſe in ſuch caſes very ſmal, and in Putrid Fevers it is evermore little in the beginning according to *Galen*.

3. In live Anatomies, if you wound the heart or the Arteries near the heart, pure blood leaps out abundantly, not frothy, nor boyling, nor heaving, and it continues as it came forth. Nor can it in a moment of time, either boyl in the Heart or Leave boyling, if it did boyl. Yea and if in two Veſſels you ſhall receive the veiny blood out of the Cava near the heart and the Arterial blood out of the Aorta near its orignal, you ſhall find no difference; neither at the firſt, nor afterwards. This *Harvey*, *Walæus*, and as many as have made trial can witneſs with me.

4. It cannot all be turned into pure ſpirit by the heart, nor ought it ſo to be. Not the former, becauſe there is not ſo much heat in a ſound heart, nor can the blood taken out of the Arteries ſet over a great fire be all extenuated, as *Conringius* hath obſerved. Not the latter, becauſe the parts for whoſe nouriſhment it is ordained, are not meerly ſpiritual.

5. Plunging into cold water would aſſwage the boyling. But the Arm being hard bound till it ſwel and grow red again, and then thruſt into moſt cold Water or Snow, when you unbind the ſame you ſhall perceive how much the Blood returning to the Heart doth cool the ſame, as *Harvey* hath taught us.

The moſt ſubtile *Renatus des Crates* and *Cornelius Hogelandius*, and *Henricus Regius* who tread in his footſteps, with equal commendation, do after another manner demonſtrate the motion of the Heart to proceed from a *Drop* or two of blood *rarified*: when the Ventricles of the Heart are not diſtended with blood, of neceſſity two large drops do fall thereinto, one out of the Cava into the right Ventricle, another out of the *venoſa Arteria* into the left, becauſe thoſe two Veſſels are alwaies full, and their Mouths towards the Heart are open, which drops becauſe of their aptneſs to be dilated, and the heat of the Heart, and the remainders of blood therein burning, preſently they are ſet on fire and dilated by rarefaction, by which the Valves through which the drops entred are ſhut and the Heart is diſtended. But becauſe of the ſtraitneſs of the Ventricles, the blood rarifying more and more cannot there abide, therefore at the ſame moment of time, it opens in the right Ventricle the three Valves of the Vena Arterioſa which look from without inwards, and being agitated by heat, it breaks out through the ſaid Vena Arterioſa, and by diſtending the ſame and al its branches and driving on the blood, makes them beat the *Pulſe*: but in the left ventricle it opens the three valves of Arteria magna looking from without inwards, and through them breaks into the great Artery, which it widens, and drives the next blood warmed and expelled by the former pulſations, into the reſt of the Arteries of the whole body, that they might be thereby diſtended. And ſo they conceive the Diaſtole is cauſed. And they ſay the reaſon of the Syſtole is, becauſe the blood being expelled out of the ventricles of the Heart, the Heart is in part evacuated, and the blood it ſelf in the Arteries cooled, wherefore of neceſſity the heart and Arteries muſt flag and ſink, whereupon way is again made for two drops more to enter, that ſo the Diaſtole may be repeated.

I dare not deny a light Rarefaction from a gentle heat, ſuch as we obſerve in the opening of a Vein, and I grant that it may be ſomtimes præternaturally augmented; but that a few drops ſhould be rarified into ſo great a bulk, as to cauſe the motion of the Heart, and that they ſhould be cooled in the Arteries, many Arguments, beſides thoſe before thoſe oppoſed to the Ebullition of the blood, do diſſwade.

1. Living Diſſections, in which neither when the Heart, nor when the Arteries are wounded, does the blood come out drop by drop or rarified, but pure, ſuch as the Ear had forced out.

2. The Heart being cut in pieces or pricked, is ſeen to pulſe, without any rarefaction of blood, which is but imaginary.

3. In ſtrong Dogs the point of the Heart being cut off, *Walæus* obſerved, that when by reaſon of the Efflux of Blood, it was not half full, it was nevertheleſs erected, but not filled by rarefaction: but when it was contracted, that portion of blood which remained in the Heart, was caſt out to the diſtance of more then four Feet. It is in vain to call in the outward Coldneſs of the Air as an aſſiſtant cauſe: for the blood in the Heart doth not grow cold in a moment, the heat thereof being yet Vigorous, as a boyling pot taken from the fire and uncovered doth not immediately ceaſe to boyl but after ſome time.

4. *Jacobus Back* doth elegantly devince the ſame from the ſtructure of the heart and its Veſſels. For the Muſculous fleſh of the heart being firme and

ſtrong, is unapt to riſe and fall by the bare Rarefaction of the blood. A more vehement action is requiſite to move this vaſt bulk. Alſo the Arteries of the heart ſhould have had a greater Orifice, and the rarefied blood being to go forth would require a larger ſpace, then was neceſſary for its entrance.

5. A Confuſion would ariſe in the motions of the Heart and valves, as he obſerves. The Diaſtole of both of them would be performed in the ſame time, and ſo the valves ſhould be uſeleſs, both which is repugnant to experience. Moreover the valves muſt, be both ſhut and open, in the Syſtole of the Arterie.

6. That it ſhould be cooled in the Arteries, neither reaſon or occular inſpection will permit. It is drawn hot out of the Arteries, differing little or nothing from that which is contained either in the Heart, or near it. In the ſmall Arteries there is indeed no Pulſe felt, but that is to be imputed to the ſmalneſs of the veſſels and their diſtance from the Heart which forces the blood. Nor ought it becauſe it enters into the Capillary Veſſels, that it may nouriſh the parts with hot Blood, not with ſuch as is cooled and thickned, before it is changed into the ſecondary humors. And what uſe is there of rarefaction, if it preſently ſettle again.

The Experiments and Reaſons which learned men bring to the contrary, from an Eele and an hunting dog, from the contraction of the members by Cold from palpitations, from ſpirit of wine reſembling the Pulſe, from vehement protruſion &c. are eaſily anſwered if you conſider

1 That a certain motion is reſtored even in Hearts that are dead, by exciteing their heat as in Muſcles.

2 The Fault is in the Veſſels contracted by Colds not in the Blood. when they fall in and flag.

3 Palpitations ariſe from plenty of blood, as examples teſtifie, ſuppreſſion of the Courſes, and the cure by blood-letting.

4 In the Heart there is an even motion, different from that which raiſed by ſpirit of wine or any thing elſe.

5. The protruſion by pure blood is more vehement, if the faculty concur, and the Fibres of the Heart be united.

6. The Heart is in its Periſyſtole or very near it, when in the point cut off, no dilatation is obſerved, if it continue ſtill in the Syſtole, the dilatation is not felt, till the Diaſtole follow.

Whether there be a pulſifick Faculty.

The *pulſifick Faculty* implanted in the Heart, muſt needs be joyned with the blood as the cauſe of its motion, either that it may guide the influx and egreſs of blood, and aſſiſt the ſame, which would otherwiſe proceed diſorderly, as I explain the matter; or that it might of it ſelf produce the motion, according to the Opinion of the Ancients, which cannot be conſerved, if the perpetual flux of the blood ſhould be ſtopped. That the Heart ſtands in need of ſuch a faculty I prove

1. Becauſe the Pulſe would be alwaies unequal, the influx being unequal, unleſs directed by ſome Faculty.

2. When the Heart in Feavers is more vehemently moved then ordinary, through the urgency of heat, and in dying perſons Nature being at the laſt pinch, and uſing all her might, yet is the motion of the heart weak, as appears by the Pulſe, becauſe the inbred Faculty is either loſt or weakned. Contrariwiſe, though the ſaid Faculty be ſtrong, and the influx of the blood ceaſe or be hindred, after large bleedings, or by reaſon of Obſtruction of the Veſſels, either in the whole Habit of the Body, or the paſſages thereof, or near the Heart, the Motion of the Heart fails. And therefore both are to be joyned together as primary Cauſes.

3. Any Particles of the Heart being cut off, do pulſe by reaſon of the reliques of this Faculty or Spirit remaining.

4. The Heart being taken out of the Body, or cut in pieces, lightly pricked with a pin, does preſently pulſe, as *Walæus* hath obſerved.

5. It were contrary to the Majeſty of the principal Part, to be moved by another whether it will or no, without any aſſiſtance from it ſelf, and ſo to receive a violent Impreſſion.

Regius hath ſubſtituted the influx of Animal Spirits into the fibres of the Heart inſtead of Animal Spirits, and *Hogeland* the little petite Atomes of the blood moved in the Parenchyma. But we muſt know in the firſt place 1. That the motion of the Heart is Natural which laſts perpetually, yea againſt our wills, and when we are aſleep, and not Animal. 2. That we exclude not the Spirits, which are the Souls Servants and Inſtruments. 3. The ſmall Boddikies or indiviſible Particles of the Blood, have all dropped out in diſſected Hearts, becauſe the *Vena coronaria* was cut aſunder. And that if any reliques of the ſaid Bodikies did remain, they could not be excited to motion, either by pricking alone, or by raiſing heat, unleſs a Spirit or Faculty be allowed, which being extinguiſhed, though the pieces of the Heart be laid in never ſo hot a place, they will never pant.

Remote Cauſes of the motion of the Heart.

Among the *Remote Cauſes* there is

1 The vital *Spirit*, as well that which is implanted in the Heart, as that which comes thither from without, with *heat* ſufficiently manifeſt in live diſſections, and which warms the whole Bodie. And that either not *ſhineing with light*, as moſt will have it, or *ſhineing*. That a lightfull heat of the Heart is requiſite in this caſe, many things argue. 1 The motion of the Elements is ſimple, never circular, and light moves it ſelf and the humors with a circular motion. 2 The Heart and the Blood are more quickly moved by light then otherwiſe they could be, which in the twinkleing of an eye, dazeles all things, illuminates all things. 3. There is in all particular parts beſides the obſcure principles of the Elements, alſo a lightfull part propagated from the ſeed, which ought to be preſerved by a like flame, kindled from the Heart 4 In *Hippocrates* to dream of pure and brightly ſhining ſtarrs, ſignifies Health of Bodie. 5 No Humor although hot, does pant and move it ſelf, unleſs a burning flame, as we ſee in ſpirit of wine, a Candle, and other things. 6 In Glow-wormes their hinderpart only pants and ſhines, where their Heart is, of whoſe light I have diſcourſed in my *Second Book of the light of Animals* Chap 11 and 12. That the vital ſpirit is really endued with light, and that there is an inbred light in the Blood and Heart, which helps forward the circular motion of the blood, I have demonſtrated in my ſaid Treatiſe Lib. 7. Cap. 5. 23. *Helmont* conſents that the animated ſpirit, in the left Ventricle of the Heart, inlightned by the former light, is the Mover of the Heart. After *Caimus* and other ancient Authors, *Ent* aſſerts the ſame thing touching the flame, raiſed out of the Seed in the firſt bladder of the Heart raiſed by the heat of the Hen which hatcheth, and firſt of all ſhineing forth, when the Lungs perform their office. yet he errs, that in the external widening he begs, in the Conſtruction more inwardly he tends to the beginning: for in the Syſtole all that illuminats

is

is expelled, and then it is vigorated in a narrow heart, which is evident in optick tubes and hollow glaſſes. I ad that in the Diaſtole of the left Ventricle, it ſets on fire and kindles by the Syſtole from the Lungs, the vital flame.

2. The Shape and Conformation of the Heart and Veſſels being exceeding well fitted to receive and expell the blood. Eſpecially the *fibres* of the Heart, and the *fleſhy columns*. Theſe make not ſo much for the Strength of the Heart alone, as for the motion. For all the fibres being contracted greater and leſſer, in the walls and ſeptum, which according to *Harvey* are circular, as in an artificial Net, or Purſe ſqueezed, the contents are expelled. They are ſtretched in the Syſtole, and remitted in the Diaſtole. By help of the ſmaller fibres, wherewith the fleſh is interwoven, a *languiſhing* conſtriction is made, but to a *ſtronger*, thoſe greater fleſhy ones concur contained in the Ventricles, which *Walæus* often obſerved in live Bodies diſſected.

3 The *Pulſe* of the Heart, the Blood and the extream parts, the pulſe is from the Heart, which ceaſing, the motion alſo ceaſes. Now it begins from the vena cava, and is continued from the Auricula dextra, by and by from the right ventricle into the Vena arteriosa, or if the point be cut off, externally from the *Arteria venoſa* into the left Earelet, thence into the left Venricle, out of which the Pulſe is felt by a manifeſt conſtriction to goe into the Aorta, in the Anatomy of living Creatures.

They drive, becauſe 1 The Blood is offenſive by its Quantity. 2 They are moved being irritated by any external force. 3 Blood is continually ſuppeditated. For *Blood* thruſts and drives on Blood, ſo that even after the Heart has bin taken out of Bodies, *Walæus* has ſeen a quick motion of the blood in the veins. Which nevertheleſs did not happen by any proper power, which the Blood has to move it ſelf, but partly by the driveing of the *external parts*, which remitt or ſend back that which remains after nutrition as burthenſome and ſuperfluous, partly by a ſpontaneous contraction of the Veſſels filled with Blood, whoſe Arteries in living Bodies being bound towards the Heart, do ſwell; towards the extream parts they are empty: But the Veins too near the ſmalleſt branches and the parts from which they bring back the Blood are puffed up, but are flat where they look towards the Heart, to which they drive the Blood; in a word, partly by the contraction of the *muſcles* and their driving, in the fleſhy and outward parts, as *Harvey* obſerves.

4 The *Attraction* of the Heart and Parts, leaſt they be deſtitute of aliment profitable and ſufficient for them, which we obſerve according to Nature in thoſe parts that are nouriſhed; but beſides nature in wounds, Ulcers, Tumors, &c. And this may eaſily be done, becauſe the blood diſperſed in all places, is immediately faſtened to the Heart and Parts which draw it, the Pulſe of the cava and Arteries aſſiſting the ſame.

Chap. VII.

Of the parts of the Heart in ſpecial, viz. the Earlets, Cavities, Septum, Veſſels, and Valves.

THe parts of the Heart which are ſpecially to be conſidered, are either externally ſeen as the *Earlets*; or within only, as the *Ventricles* or two Cavities, the *Septum* or partition, and the *Veſſels* with the Valves.

The Earlets of the Heart why ſo called?

The *Earlets* or little Ears, were ſo termed, not from hearing, but becauſe of ſome reſemblance in their ſhape. For from a long Baſis they end in a blunt point (howbeit the left is more accumulated) of an obtuſe triangle; and they have a Cavity, that the Ventricles might be produced before the Heart. For that ſame pulſing Bladder in an Eg, is the Earlets, becauſe they were neceſſary in the Child in the Womb, though the Heart were not ſo ſoon neceſſary, which afterwards grows upon the Bladder. Others give another reaſon, becauſe the Earlets obſerve the ſame proportion in their pulſing as the Bladder had. But this is very hard to diſtinguiſh in the firſt Generation. *Others* take the Bladder for the Heart, whoſe Expanſions or Earlets appear red, becauſe they are tranſparent, but the Heart is not ſeen by reaſon of the plenty of Seed, and Pulſe intermitted. I ſuſpect that both may lie hid under the *Veſicula* or bladderkie, but that the Earlets are preſently drawn and moved, becauſe of their uſe. Otherwiſe it would ſeem inconvenient that the Appendix ſhould be greater then the whole Body. Nor is the Heart a bare Parenchyma or affuſion of blood. It hath Cavities produced doubtleſs out of the foreſaid Bladderkie.

What pulſes firſt in an Eg.

Now the EARLETS are Proceſſes or Appendixes; and according to *Hofman*, nothing but the Subſtance of the Heart attenuated and widened. Which I know not how true it is. I ſhould rather ſay they ſeem to be the ſubſtance of the neighboring Veſſels dilated, although they are made firſt of Seed out of the bladder, and are the firſt motion, and the laſt in dying.

Their Situation.

They are *ſituate* at the Baſis of the Heart, before the Orifices of the veſſels venal to which they cleave, and whereby they are mediately joyned to the heart. They are on each ſide one

Number.

For two they are in *Number*, anſwerable to the number of the Hearts Ventricles, the right Earlet being greater, and the left ſmaller. And both are large in an Embryo or Child in the Womb: the former is joyned to the *Vena cava*, with which it ſeems to be one common body; the latter to the *Vena arteriosa*.

Subſtance.

The *Subſtance* of the Earlets is peculiar, ſuch as there is none in any other part; by reaſon of their ſingular uſe. Howbeit they are thin and ſoft, for their more eaſie contraction and nervous for ſtrengths ſake. But the left is more hard, a little more fleſhy and thicker; yet the Heart is not ſo. Howbeit they anſwer in a certain proportion to the Ventricles of the Heart.

Their Surface.

Their external *Surface*, when they are extended and full, is even and boſſie or bunching (but their circumference unequal) when they are contracted, it is wrinkled; and in the left it is more wrinkled then in the right, becauſe the inner fabrick is more turning and winding, and hath more pits in it, for

The Earlets being *inwardly* diſſected and ſpread open, do diſcover unto us 1. a certain fleſh-membranous *plain*, ſtretched out to the extremities of the treble pointed Valves, to which the fibres of the Valves are faſtned. 2. About the whole circumference fleſhie Columnes grow out, firſt the great crooked ones,

Out

out of which Spring many lesser ones, with a wonderfuland neat contexture, somtimes single, somtimes wreathed, and infolded either with the great ones, or with one another. 3. Between these Columnes deep *Pits* are seen, more in the left, fewer in the right. In the middle partition of each Earlet. *Folius* hath found out many *little Holes*, which I have also seen, through which he conceives the blood is carried into the left Ventricle, when there is need of less matter. But seeing they are rarely to be seen, nor do they penetrate into the Ventricles, yea they are less, I am more apt to think they are Pores common to many, serving for motion, or the nutrition of the Part.

See Tab. IV. of Book II.

Botallus hath found a *Passage* sufficiently visible near the right Earlet, which goes presently right out, into the left Ventricle. This *Walæus* explains to be ment of the oval hole, or that passage by him observed, which goes obliquely out of one Earlet into the other. Such an one I have often seen in Oxen and Goats, but it is the coronal Vein, nor does it pierce into the left Earlet, but descends into the Parenchyma of the heart.

As to their *Colour*: In an Infant in the Womb some months old, they are red, by reason of the abundance of purple blood, according to the Observation of *Harvey*. I have observed the same in the Conceptions of beasts, the Heart being white and bloodless, and the Earlets

Their Colour.

The FIGURES Explained.

FIG. I.

Shews the Heart cut in sunder athwart.

A. *The Basis of the Heart.*
B. *The Point of the Heart.*
C. *The right Earlet.*
D. *The left Earlet.*
EE. *The Shape of the left Ventricle like an half Moon.*
FF. *The Cavity of the left Ventricle.*
GG. *The partition between the Ventricles.*

FIG. II.

Shews the Vena cava with the right Ventricle dissected.

A. *The Orifice of the Coronary Vein.*
B. *The Appearance of an Anastomosis, between the Vena cava & Vena pulmonalis.*
CCC. *The trebble-pointed Valves with the Fiberkies wherewith they are fastned.*
D. *The Ventricle cut long-waies.*

FIG. III.

A. *The right Ventricle of the Heart opened.*
BBB. *The Sigma-fashion'd Valves, visible in the Vena arteriosa.*

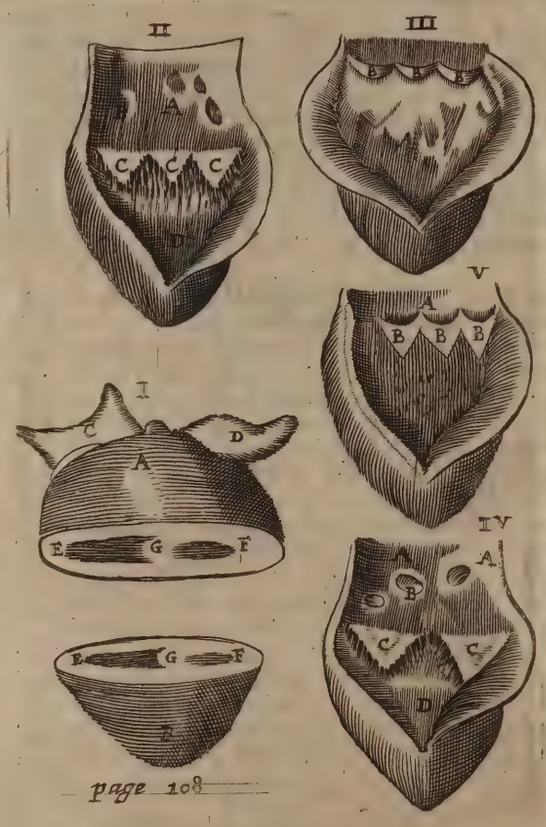
FIG. IIII.

AA. *The Arteria venosa dissected.*
B. *The Print of an Anastomosis between the Arteria venosa and Vena cava.*
CC. *The two Mitre-shap'd Valves.*
D. *The left Ventricle opened.*

FIG. V.

A. *The great Artery cut asunder near the Heart.*
BBB. *The Semilunary Valves, in the Orifice of the great Artery.*

The V. TABLE.



full of blood and ruddy. In grown persons they are commonly more obscure then the Heart it self, when they move not, but in their motion they successively change their colour, as the Heart does; for being moved they are pale, because they expel the blood in their contractions, which does most of all appear in their extremities; they grow red again in their Diastole, when they have received blood.

Their Motion.

Their *Motion* is manifest to the sense in live Anatomies, by reason of the blood rushing in, and filling them, wherewith they swell in living bodies, and by their contracting themselves, by means of their fleshy fibres contracted into themselves, endeavoring to force the blood out into the Ventricles.

There are three parts of their motion; *Systole, Diastole*, and the rest or pause which comes between them, which cannot be discerned, save in persons ready to die, for they are performed so swiftly in sound persons, that they seem to be confounded, and to be performed all at once, as in the discharge of a Gun, all seems to be performed in the twinkling of the eye, and in swallowing, as *Harvey* informs us. The

The *Diaſtole* is cauſed by the blood received from the Vena Cava and Arteria Venoſa. The *Syſtole* is performed, when the Earlets being filled, do by contracting themſelves, expel the Blood into the Ventricles.

The Diaſtole and Syſtole of both the Earlets, do happen at one and the ſame time. When the right Earlet undergoes its Diaſtole, at the ſame time the left Ear undergoes the ſame; when the latter is contracted in the Syſtole, the former alſo expels. But the Diaſtole of the Heart and Earlets, happens at different times, as alſo both their Syſtoles. The Syſtole of the Earlets happens at the ſame time with the Diaſtole of the Ventricles, and contrarily, and the conſtriction of the Earlets doth alwaies forego the Diaſtole of the Ventricles, both in healthy perſons and in ſuch as are at the point of death. But the motion of the former is more laſting then the motion of the latter, When the left ventricle ceaſes, the left Earlet ſtill continues pulſing, which being extinct, the remaining motion is in the right ventricle. and that ceaſing, the right Earlet proceeds panting, being the laſt that dies, ſave that when it ceaſes, a certain trembling motion doth as yet continue in the blood which flows in, by reaſon of the driving of the extream parts.

Their uſe. Their *uſe*, is I. To be Store-houſes to the Heart; for they firſt received the Blood and Air, that they may not ſuddenly ruſh into the heart, whence the heart might be hurt, and the Animal faculty ſuffocated. And hence it is that they are placed only at the veſſels which pour into the heart, and not at the Arteries which void the blood forth.

II. To ſafeguard the veſſels to which they are joyned.

III. To be inſtead of a cooling Fan to the Heart, according to *Hippocrates*.

IV. According to *Walæus*, to be in place of a meaſure, by which the vena Cava and Arterioſa do meaſure the blood into the heart, for ſeeing all the blood was not to go out, at every pulſe, but the greateſt part was to ſtay behind to be further perfected, nature joyned the Earlets to the heart, as veſſels which ſhould give in ſo much blood to the Heart, as was naturally to be caſt forth at every pulſation. For which cauſe he thinks it is, that the right Earlet is greater then the left, becauſe the right Ventricle is more Capacious then the left, and like more is voided therefrom then from the left, viz. ſooty Exhalations and the Nutriment of the Lungs.

The Ventricles of the Heart. The CAVITIES of the Heart or its Ventricles, Chambers, or Caves &c. are not three, as *Ariſtotle* falſely aſcribes to greater Beaſts, for three are not found, no not in a Whale, but only two, as *Walæus* and *Sylvius* have obſerved in the diſſection of a young Whale. Nor did *Galen* at Rome find more in an Elephant. And by a very rare chance three were obſerved by *Æmilius Pariſanus* at Venice in the Heart of a certain Coverlid-maker. And *Veſlingius* twice obſerved the like. Alſo *Walæus* ſaw a third Ventricle in the Heart of an Oxe. *Cæſalpinus* obſerved three in Birds and Fiſhes, and the right Ventricle doth eaſily appear to be divided into two near the point, by a certain thin Partition, yet in truth both come into one. *Licetus* underſtands that ſame third Ventricle of *Ariſtole*, to be the Prominency of the right Ventricle, turned in beyond the left, ſo that the left Ventricle commonly ſo called is *Ariſtotles* middle Ventricle. *Conringius* doth otherwiſe excuſe *Ariſtotle*, viz. that the right Ventricle in his account is whence the Cava ariſes, the middle whence the Aorta ſprings and the left, whence the Arteria Venoſa or left Earlet ariſes, which being the leaſt of all, is in ſmal Live-Creatures hardly viſible. But ſo there ſhould be four Ventricles, the Vena Arterioſa being added, as at firſt ſight may ſeem, not three only. There are therefore only two Cavities found in the Heart of a Live-wight, the right and the left, having their inner ſurface uneven and rough, eſpecially the left. The Heart of a certain Polander cut up by *Riolanus*, was perfectly ſolid, having no Ventricles at all.

Many *Pits* are formed in them by the fleſhy Fibres, in the right more, but narrower, in the left fewer, but deeper, that they might contain the blood received in, hence in the Conſtriction of a Living Heart they are leſſer, in the Dilatation wider. The Pits are conſtituted and fenced by

Fleſhy Pillars in the Ventricles of the Heart. Thoſe *fleſhy Particles* termed *Lacertuli* Muſclekies, ſomtimes round, ſometimes thin, being five or more in the right, two only viſible in the left, but very thick ends. *Veſlingus* obſerves that the larger have Pores which paſs through them. The *uſe* of them, is according to ſome, to be Ligaments of the Heart. *Maſſa* counts them little Muſcles. *Veſalius* and *Riolanus* call them *Columnæ carneæ*, fleſhy Pillars, which being contracted, do further the *Diaſtole* of the Heart. *Pariſanus* ſaies by help of them the Heart contracts it ſelf, *Walæus* alſo hath obſerved in live Diſſections, that they aſſiſt the Contraction or Syſtole of the Heart, eſpecially when it is ſtrong and vehement, at what time their ſwelling begins at their Baſis, and goes on by little and little unto the point. *Harvey* ſaies they draw the Cone or Point of the Heart to the Baſis or broad end thereof, by their oblique fibres. And he is apt to think that heat is carried through all of them. *A. Benedictus* and *Ent*, that they hinder the blood from going into Clotters, while it is ſhaken and agitated by them. *Backius*, that they are inſtead of Ropes and Bands, to hinder leaſt in the Contractions of the Heart, the Valves being forced beyond their pitch and overſhot, ſhould be unable to retain the Blood. *Slegelius* will have it that they are contracted, that they may ſhut the Orifices of the Veſſels of the Cava and Vena Arterioſa by their Fibrekies. All theſe Opinions are true and muſt be joyned together, as will manifeſtly appear to him that ſhall accurately conſider the times of the motions of the Heart.

Things preternatural found in the Heart. Many things are preternaturally found in the ventricles of the Heart. *Bauhin* hath found bits of fat, and our moſt expert Countryman *Wormius* hath took out of both the ventricles certain Caruncles or ſmal particles of Fleſh, whiteiſh within, but of a ſhining red color without; which I alſo have long ſince found, at *Padua* and at *Hafnia* in my Diſſections, both of Men and Beaſts, *Eraſtus* hath found a Flegmatick concretion, like yellow marrow, which is found, in the boyled bones of Oxen. *Veſalius* two pounds of Glandulous and blackiſh fleſh, *Benivenius* a Gobbit of fleſh like a Medlar.

Salvius hath obſerved Worms, as alſo *I. D. Horſtius* at *Confluentia*; *May* a twibladed Snake like a Whip at *London*, and *M. A. Severinus* much ſuch another at *Naples*. *Hollerius* found ſtones (with an Impoſtume) in a woman troubled with the ſtone; and *Wierus* ſtones as big as Peaſe.

A Bone in the Heart.

Bones are more rarely found in the Hearts of Men. Yet *Gemma* did once find some, and *Riolanus* twice, in the dead body of president *Nicolas* being eighty years of Age, at the beginning of the Aorta, and in the Queen Mother of *Lewis* the thirteen King of *France*, being after her decease opened to be Imbalmed. *Johannes Trullus* found one in the Heart of *Pope Urban* the eighth of a triangular Figure representing the letter T. *Simon Pauli* my Renowned Predecessor in the Anatomical Theatre, took a bone as hard as a stone of a Figure of the *Pythagoræan* letter Y, out of the Heart of a Man of *Hasnia* forty years of Age, the bigness of a Wallnut, and the shape not unlike the Heart. I conceive they are all bred through the dryness and slow motion of the Humors in aged and sick Persons. Yet nature makes use of this defect to provoke and quicken the motion of the blood, when it passes slowly, as waters flow more easily when a peice of wood is cast in, or that all the blood may not clotter, as our Women and Butchers stir their blood about with a stick, when they intend thereof to make Puddings, that it may not go into Clotters.

The right Ventricle.

The *right Ventricle* receives blood out of the Vena cava, which Vein it receives into it self: And therefore it hath not so thick a flesh or wal, as the left hath, that their might be an even poise, seeing it contains more matter, and bears a greater weight then the left. Nor is there so perfect a Concoction made in this Ventricle, as in the left in which there is more heat.

It is not exactly round but semicircular, resembling the Moon encreasing, nor does it reach to the End of the Point, but it seems to be as it were an Appendix to the left Ventricle, which when the left is taken away, seems still as it were to represent an whole Heart.

Yet is it deeper and larger then the left, by reason of the store of blood, which it was to contain, both to nourish the Lungs, and to make vital Spirits in the left Ventricle. For

Its *Use* is 1. To receive blood out of the vena cava, to nourish the Lungs, the said blood being poured into the Lungs through the *Vena arteriosa*. Therefore Fishes which have no Lungs, and draw no Air in at their Mouths, are without this Ventricle, having no more then one. This right Ventricle therefore, does concoct and attenuate the Blood, for the Nourishment of the Lungs.

II. To send the thinner part of the Blood through the Septum or partition, into the left Ventricle, to make vital Spirits; and the thicker part through the Lungs, both to nourish them, and that it may return to the left ventricle, for the Nutriment of the whole Body.

III. Further to perfect and prepare the blood which runs back as superfluous after the extream parts are nourished, and the crude blood which is bred in the Liver.

The left Ventricle.

The *left Ventricle* is narrower, but more noble; having a round Cavity, and which reaches unto the point of the Heart. Its flesh or wall is three times as thick as that of the right ventricle. Also it is harder, that the vital Spirits may not exhale, and that the motion of the blood might be stronger, being to be forced into the fartheſt parts of the body.

Its *Use* is to make vital Spirit and Arterial blood, of a twofold matter, I. Of blood prepared in the right ventricle, and passed through the Septum and the Lungs. II. Of Air drawn in by the Mouth and Nostrils, prepared in the Lungs and transmitted through the *Arteria venosa* with the blood into the left ventricle of the Heart, to kindle and ventilate the vital flame, yea and to nourish the same. The latter fishes stand in need of and Leucophlegmatick persons, the former such as are seated in a narrow or infected place, or are under extream heat, for fear of suffocation and extinction of the flame in the Heart.

The *Use* therefore of both ventricles is in a manner the *same*, viz. to generate Arterial blood, and to perfect the venal, and to receive the same running back from all parts of the body through the veins, and to expel the perfect blood through the Arteries into the fartheſt parts of the body, that they may be thereby nourished. This is proved by the Conformations of the ventricles, which in part are like one to the other, in the right two vessels, a Vein and an Artery carrying out, and bringing back, and as many in the left. In the former are two sorts of Valves the trebble pointed, and Mitre-shap'd, and the like in the latter. The left expels and receives as much as the right, save that it is consumed in nourishing the Lungs and the Heart. Yet their different Constitution and Magnitude, argues some difference. Whence 1. There is a different Coction in the one and other, as hath been demonstrated above. 2. The right works for the Lungs the left for the whole Body. 3. The right sends sooty Exhalations and blood to the Lungs; the left receives from the Lungs Blood Impregnated with Aire.

There is a *Septum* or *Partition* between the two Ventricles, which is thick like the other Wall of the left ventricle (which *Columbus* once observed to be Gristley) hollow on the left side, on the right bunching, full of hollownesses and holes, which some suppose to be the third ventricle of *Aristotle*; which hollownesses or Caves are more large towards the right side, but their utmost ends towards the left side are hardly discernable. *Helmont* describes them to be triangular, whose Cone ending in the left ventricle, is easily stopped, but the Basis of the said triangle in the right ventricle, is never stopped save in Death. But I have seen them Circular so that they could easily admit a Pease, but obtuse towards the left Hand.

Manifest Pores in the Septum of the Heart.

That they are open is the opinion of the Ancients and of many Anatomists which follow them. *Gassendus* saw *Payanus* at *Ajax* shew the Septum of the Heart to have through-fares, by reason of sundry windings and crooked Cony-holes as it were, and that by lightly putting in his Probe, without any violence, which he wreathed gently and turned it upwards and downwards and to the sides. And although by a Probe breaking the tender flesh of the Septum, we may easily make a way, yet we may not doubt of the Eyewitness of *Gassendus* nor of the Dexterity of *Payanus*; seeing I also of late found the partion of a Sows Heart, in many places obliquely perforated with manifest great Pores, which were open of themselves without the use of a Probe, so as to admit a large Pease; but when I put in my Probe, it brought me to the left ventricle, where a thin Membrane as it were an Anastomosis was placed, hindering any regress. *Riolanus* also hath seen it bored through towards the point, where it is most thin. *Walæus* in the Partition of an Oxes Heart, did somtimes find a Cavity in the upper part according to the length of the Heart, open into the left ventricle about the point of

of the Heart, the length and breadth of a Mans Fore-finger, which he conceives to be the third Ventricle mention'd by *Ariſtotle*.

Yet are they not alwaies open in dead bodies, becauſe in living bodies they are kept open, by the continual agitation of the Heart, which ceaſing, they are not ſo viſible to the Eye-ſight, even as we ſee no manifeſt paſſages. when the ſweat breaks out plentifully through the Skin, nor when the ſeed breakes out of the Kernels and Spermatick veſſels, inro the Urinary paſſage: nor the Pores by which the Empyema or out of the blood out of the vena Arterioſa peirces into the Arteria venoſa, through the ſubſtance of the Lungs, or the blood in the Liver, out of the branches of Porta into the Cava. *Cælſius* is in the right, where he ſaies, that nothing is more fooliſh, then to think that look what and how it is in a living Man, ſo it muſt needs be in one that is dying, Yea that is dead. Whence many (as *Columbus*, *Spigelius*, *Hofman*, *Harvey*, *&c.*) have denyed that any thing paſſes through this Septum or Partition. But it is no wonder that they make a doubt of it: For,

I. They are ſo crooked and winding, that a Probe cannot eaſily paſs through them. Howbeit theſe Pores become more conſpicuous, in the Heart of an Ox long boyled, as *Bauhinus*, *Riolanus*, my ſelf with others can witneſs. And you are to obſerve, in oppoſition to *Hofman* and *Plempius* that deny it. that in the boyling a moderation muſt be uſed, and that the Fibres in living Bodies do never ſtick ſo cloſe together, but that they leave Pores, as the Nerves do ſhew, finally, that the quickeſt-ſighted Anatomiſts can ſee no Membrane in the boyled Hearts of Oxen. II. In dead Bodies all paſſages fall in and ſhrink together. III. That an extream ſtraitneſs was requiſite in the End; becauſe the thinneſt part of the Blood, is ſtrained as it were in that part: And in the mean time, becauſe theſe holes are not in vain, therfore,

Whether the Blood paſs through the partition of the Heart?

The *Uſe* of the Septum or Partition of the Heart, is, that the thinner blood may paſs there-through into the lef ventricle, for the Generation of vital blood and ſpirit, which is afterwards diſtributed through the Arteries into the whole Body, for to preſerve and ſtir up the life and natural heat. But the thicker and greater part of the blood, by a natural and ordinary way, and not a violent only, is communicated to the Arteria venoſa, through the vena Arterioſa, by mediation of the Lungs, that in the left ventricle it may be mingled with that which ſweats through the Septum. The thicker part is ordained to nouriſh the Lungs, and that it may return back to the left ventricle tis tempered with Air. The thinner part paſſing through the Septum, nouriſhes the ſame in its paſſage, becauſe the external Coronary veſſels do only creep through, and in that long and dangerous journey through the Lungs, it would vaniſh away and come to nothing. By this way only ſuch as dive deep into the Sea, and thoſe that are hanged for a ſmal while, do live a while and come to themſelves, after the motion of their Lungs is ceaſed.

The *Motion* of the *Septum* or *Partition* doth help forward this paſſage, which that it is moved according to the motion of the Ventricles, I have theſe ſigns and tokens; Becauſe 1. It is furniſhed with Circular Fibres, as well as the Walls, in a boyled Heart, ſuch in a manner as are in the Sphincter Muſcle, as *Harvey* teſtifies, which ſeeing them move the Ventricles, they muſt as well move the Septum. 2. A certain Palpitation is felt, if you put in your Finger into a living Heart, according to the obſervation of *Walæus*. 3. In Creatures ready to die, when the motion of the left ventricle ceaſes, the Septum follows the motion of the right Ventricle, as the ſame *Harvey* obſerves: and if the right Ventricle be wounded, *Riolanus* tells us, that the motion remains in the Septum in his *Obſervations*. Yet the ſame *Riolanus* in another place being wiſer, denies that it is moveable, unleſs towards the Baſis where it is ſoft gives way a little, and that ſo it ought to be that the paſſage may be maintained, becauſe when the Ventricles are dilated above the through-far'd Septum, and ſtraitned again like Bellows, the little holes would be ſhut up. But there is no fear. For in the Syſtole, when the point is drawn back to the Baſis, the Pores are opened in the Septum moved upwards, that the blood may at once paſs both the Septum and the Lungs. Contrarywiſe in the Diaſtole, becauſe the Heart is diſtended long waies, the pores are drawn back with the Septum, and are ſhut up, until the Heart be filled.

Veſſels of the Heart.

As to the *Heart-veſſels* there are found four remarkeable ones going out of the Heart which *Hippocrates* calls the Fountanes of Humane Nature. Into the right Ventricle are inſerted two Veins; the *Vena Cava* and *Vena Arterioſa*; into the left, as many Arteries; *Arteria Venoſa* and *Arteria Magna*. Before all which are placed within eleven *Valves* or little dores, made of the Tunicles of their Veſſels widened and ſtretched out. The Veins which bring in to the Heart, viz. the Cava and Arteria venoſa, have trebble-pointed valves, looking from without inwards; the Arteries which *carry away*, viz. the Aorta and the Vena Arterioſa, have Sigma-ſhap'd or Mitre-faſhion'd valves open inwards, ſhut outwards. The former admit blood into the Heart; being open they ſuffer the blood to flow out, being ſhut they hinder it from returning the ſame way. The trebble-pointed valves do not only wink, but they are cloſe ſhut by the blood diſtending the Heart, and by the conſtriction of the Heart which ſtraitens the veſſels. The Sigmoides or Sigma-ſhap'd are ſhut by the Relaxation and falling in of the Heart in the Diaſtole, whereby the Fibres being ſtretched out long-waies, they are drawn downwards with the Walls and ſo ſhut, like the Chains in Draw-bridges.

The *Trebble-pointed* or *Tricuſpides*, are opened by the impulſe of new blood through the Cava, and Arteria venoſa, and the Diaſtole of the Heart, whereby the Fibres being drawn downwards, they are opened; But the Mitre-ſhap'd valves, are open'd in the Syſtole by the Conſtriction of the Heart, and the blood urgeing its way out. Alſo they may be præternaturally ſhut, by the blood expelled and ſtanding ſeated in the full veſſells; to which, endeavouring to run back, they make reſiſtance by reaſon of their conformation, which Artifice of Nature, we ſee every where imitated by the Flood-gates and Locks made upon Rivers. But that according to nature they are not ſhut by the returning of the expulſed blood, as ſome conceive *Walæus* proves, Becauſe 1. Our ſenſes obſerve that the blood is carried from the Heart, not to the Heart by the Arteries. 2. In a rare and languiſhing Pulſe, the Artery doth not riſe or ſwel laſt in the upper part towards the Heart, but it ſwels there firſt. 3. If an Artery be tied two fingers from the Heart, and it be ſo opened betwixt the Ligature and the valves, that the blood may freely paſs forth, yet the valves will divers times ſtraitly be ſhut, and the Heart is orderly moved.

The

The Explication of the FIGURES.

This first FIGURE shewes the right side of the Heart entire, and withall the Earlet cut off, and the Vessels which goe out of the Heart, but especially the Anastomosis by which *Folius* will have the Blood to flow from the right into the left Ventricle.

FIG. I.

AAA. *The Heart in its proper posture, over the Surface whereof, the Vena Coronaria is disseminated.*

BB. *The right Earlet of the Heart, partly dissected, partly intire.*

C. *A certain white and circular place between the Earlets, in which on one side, under a certain little skin like a valve, an Anastomosis is found, that is a wreathed winding hole, through which* Folius *will have the Blood to pass, into the left Ventricle.*

D. *The vena cava dissected, as far as to the Situation of the Liver.*

E. *The Vena Aorta which goes to the Throat and Arms dissected.*

F. *The Arteria magna ascending.*

G. *The same descending near the Back-bone.*

H. *An Arterial Pipe, which joines the great Arterie with the Arteria venosa.*

I. *The Arteria venosa yssuing out of the right Ventricle of the Heart.*

K. *The Vena Arteriosa, Nurse of the Lungs, yssueing out of the left Ventricle.*

aaaa. *The Vena coronaria radicated and diffused through the surface of the Heart.*

b. *The beginning of this Vena coronaria, in the Earlet near the Vena cava.*

cccc. *A certain portion of the Earlet dissected.*

dd. *The other part remaining yet intire.*

ee. *A Probe thrust into the Anastomosis.*

f. *A little skin like a Valve placed at the mouth of the Anastomosis.*

gggg. *The Branches of vena cava, spred up and down and rooted in the Liver.*

hhh. *Ascendent branches of the Arteria Magna.*

FIG. II.

This other Figure shewes the left Ventricle of the Heart, as also the Earlet dissected, together with the going out of the Probe, demonstrated in the first Figure.

AA. *The Heart cut open through the whole left Ventricle.*

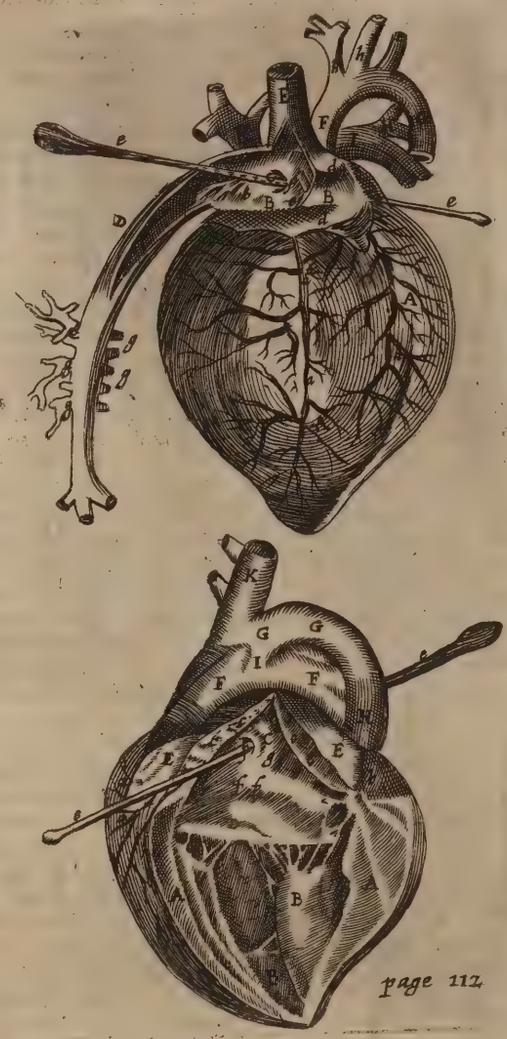
BBB. *An exact Representation of the said Ventricle.*

C. *The Egress of the Probe, through the Anastomosis, from the right into the left Earlet.*

D. *A Valve placed at the mouth of the great Artery.*

EE. *The left Earlet of the Heart dissected, being less then the right.*

TABLE VI.



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FF. *The Arteria Venosa going out of the right Ventricle of the Heart.*

GG. *The Arteria Magna ascending.*

H. *The said Artery descending near the Back-bone.*

I. *The Arterial Pipe knitting the Vena Arteriosa to the Magna Arteria.*

K. *The Trunk of the great Artery, ascending to the Arms and Throat.*

aa. *A certain part of Vena Coronaria dispersed through the surface of the Heart, the smallest part thereof is visible.*

bb. *The Arteria Coronaria dissected.*

cccc. *The left Earlet cut open as far as to the Vena Arteriosa.*

dddd. *Certain Nervous particles, in the very Ventricle of the Heart, accounted Nerves by* Aristotle.

ee. *The Probe thrust in through the Anastomosis.*

fff. *Certain smal holes, through which* Folius *will have the blood to pass, while the Anastomosis grows together, and there is need of less matter.*

g. *A Valve on the side also set before the Anastomosis.*

And therefore many of the *Ancients* and *later writers* are deceived, who imagined that the blood did freely paſs out of the Heart, and back again thereto. And that the valves do not naturally cloſe and open, appears by a Tumor in the Arteries between the Ligature and the Heart, and the emptying of the veins near the Heart.

Vena Cava. The *firſt veſſel* is the VENA CAVA inſerted into the right Ventricle, with a very large and gaping Orifice, three times greater then the Orifice of the Aorta, and therefore it ſeems rather to ariſe from the heart, then from the Liver, eſpecially ſeeing it ſticks ſo firmly to the right Ventricle, that it cannot be ſeparated therefrom.

Whether it hath any *motion* is hard to determine. *Ariſtotle* and *Galen* ſeem to have been of that opinion; but the Interpreters expound thoſe places to mean an obſcure motion. But *Walæus* hath diſcovered a manifeſt motion therein, from the Jugulum as far as to the Liver, but moſt evident near the heart: and that therefore even in that place the Vena Cava is furniſhed with fleſhy Fibres, whereof it is deſtitute in other places. Alſo *Ent* hath obſerved that the vena Cava of a dead Beaſt, being with a mans Finger lightly touched in the Belly near the Thighs of the Beaſt, did expreſs a trembling motion.

Its *Uſe* is, to bring in Blood from the Liver, and the whole body, by its aſcending and deſcending Trunks.

A *Membranous Circle* grows to the Orifice thereof, to ſtrengthen the heart: Which is preſently ſplit into three ſtrong Membranous.

VALVES, termed *Janitrices*, Gatewarders, looking from without inwards, that the blood may indeed enter; but not return back into the Cava.

Its treble pointed Valves. They are termed TRICUSPIDES, trebble-pointed, by the Greeks *Trichlochines*, becauſe they are like the Triangular heads of Darts, when they are ſhut, and fall cloſe one to another.

They grow, as alſo the reſt of the valves do, to many ſhreds (in the Cava commonly each one to five remarkeable Threds, intertwiſted with many little ones) whereby they are joyned to that *fleſhy particle*, before explained; which ſome call the Ligaments of the heart, others as *Ariſtotle* perhaps, the Nerves of the heart.

The Vena Arterioſa, why called a Vein? The VENA ARTERIALIS or *vas Arterioſum*, the Arterial veins or Arterial veſſel. Others call it *Arteria Pulmonaris*, the *Lungs Artery*, becauſe it is in truth an Artery, both in Subſtance and Uſe.

Twas called a Vein firſt by *Herophilus* and afterwards by moſt other Anatomiſts, before the Circulation of the blood was found out, from its Office, becauſe it ſends blood to nouriſh the Lungs.

Why call'd an Artery? Tis termed an *Artery*, I. By reaſon of its Subſtance, which conſiſts not of a ſingle Coat, as a vein doth, but of a double one. II. Becauſe in a Child in the Womb it performs the Office of an Artery, and Pulſes as ſhall be ſaid in the next Chapter, As alſo in a grown perſon, becauſe it carries Nutritive blood to the Lungs, which is partly wrought in the right ventricle.

Its Original and Progreſs. This veſſel paſſes out of the heart with a ſmaller Orifice, and yet greater then the Lungs ſtand in need of: For *Columbus* and *Arantius* obſerve, that two Fingers have been thruſt thereinto; and it ought to be the greater, becauſe it receives blood from the continual pulſation of the right ſide of the heart. Moreover, reſting upon the Arteria Magna and inclining to the left ſide, it goes to the right and left parts of the Lungs with a double branch, a right and a left: Which afterward ſpend themſelves into ſundry branches in the Lungs.

Its Uſe. It *Uſe* is, to receive blood out of the right Ventricle, and to carry it to the Lungs for their nouriſhment, and according to the obſervations of latter Authors, to paſs over the reſt of the blood through the Arteria venoſa into the left Ventricle of the Heart, and to hinder the blood from ſliding back again into the heart.

The Sigma-faſhioned Valves. Three VALVES are placed therein, ariſing from the Coat of the vein it ſelf, looking from without inwards, and reſembling an half Circle, or the letter Sigma, as it was anciently figured, and did reſemble the Latine letter C.

The Arteria venoſa, why an Arterie? The ARTERIA VENOSA, which others call *Vena Pulmonaria*, is the third Veſſel of the heart, which is ſeen in the left Ventricle.

It is termed an Artery becauſe of its Office: For I. It Pulſes in a grown perſon, becauſe it is united to the left Ventricle, but it moves not by a proper motion of its own, becauſe it is neither an Artery, nor doth it carry pure Arterial blood. II. It is implanted into the left Ventricle.

Why a vein. Tis called a VEIN, 1. Becauſe of its Subſtance. 2. Becauſe in a Child in the Womb, it performs the office of a vein. And it is produced as it were from the Cava, to which it is joyned, by way of Anaſtomoſis. Yea and in a grown perſon, it carries blood alſo to the heart, as doth the Cava.

It *Ariſes* with a round and great Orifice (greater then that of the Arteria Magna) divided into two parts preſently after its egreſs, juſt in a manner as if it aroſe with a twofold mouth; and it is diſſeminated into the right and left part of the Lungs.

The Uſe.

Whether Air enters into the Heart? I. In its Dilatation to draw Air to the heart, not bare and ſimple Air, but mixed with the blood which returns from the Lungs, for the Generation of vital ſpirits and Arterial blood, and to nouriſh and kindle up the vital flame. For the Arteria venoſa being opened in living Anatomies, doth pour blood and not pure air into the heart, which for the moſt part we obſerve thicker then ordinary in the Carcaſſes of Men and Beaſts, becauſe the motion of the left ventricle ceaſing, the blood received in this vein, cannot be driven or drawn to the heart. And when the Arteria venoſa is cut or opened, there appears no air, becauſe the air is not pure and ſimple, being mixed throughout with blood. And when the Lungs of a living or dead Creature are by Art blown up, not a jot of air is perceived to come thence to the heart; becauſe the Carriage of blood is wanting, and the natural Drawer and Driver is alſo wanting. But that the air ſuch as it is, doth come into the heart, their Examples do teſtifie, who have been ſtifled with the fums of Quick-ſilver. Coles, Lime, &c. And otherwiſe the Lungs and Lung-pipes were made in vain.

II. In the Contraction of the Heart to thruſt out a portion of vital blood, into the Lungs, together with

footy exhalations; which is an old opinion. But that in the Systole of the heart, blood or footy steams should be carried this way. 1. The Valves hinder, which will not suffer any thing to return. 2. The Arteria venosa being tied, doth swel towards the Lungs, and is lank and emptied near the heart. 3. Being opened it pours forth blood on this side the band, but beyond it being opened it voids neither blood nor footy exhalations. 4. The footy steams of the right Ventricle, do evaporate through the vena Arteriosa, turn into water in the Pericardium or Heart-bag, breed the hairs in the Arm-pits, and exale into the whole habit of the Body, through the Aorta. 5. The air which goes into the heart, and the footy steams which go out with the blood, should be carried the same way, in contrary motions, which is a thing unusal in the natural course observed in the body. For though ever and anon Excrements are driven from and Nutriment is drawn to the same part, yet the way is different, especially where the afflux is continual, as in the Arteria venosa from the Lungs; or at least they are performed at different times. Therefore.

III. In the contraction of the heart, it drives blood which is superfluous after the nourishment of the Lungs, or that which runs back, out of the vena Arteriosa, into the left Ventricle of the heart.

The Mitre-shap'd Valves. Two Valves only are placed at the Orifice of this vessel, which look from without inwards (bred out of the Nervous circle which grows out of the substance of the heart) which being joyned together do resemble a Bishops Mitre, They are greater then the Valves of the Cava, have longer threds (and each hath seven large ones, besides little ones annexed to them, which from a broad Basis do commonly end into a sharp point) and for strengths sake very many fleshy Explantations. Therefore two were sufficient to shut the Orifice close, because they are greater then others, the Fibres longer and larger, the Columnes or Pillars stronger, and the Orifice it self is more Ovall-shap'd, then that of the rest.

The Arteria Magna. The Arteria Magna or *great Artery* so called, because it is the root of all others, is another vessel of the left Ventricle, from whence it proceeds and arises.

At the Orifice hereof, is placed instead of a Prop, not in Men, but in certain Beasts, as Harts, Oxen, Horses, &c. a certain hard substance, which is somtimes Gristly, somtimes Boney, according to the greatness and Age of the Beasts. In man the most noble and strongest, *Harvey* saw a portion of this Artery turned into a round bone, near the Heart, whence he concludes that the Diastole of the Arteries, is caused by the blood alone, not by any Pulsifick faculty, derived through the Membranes. Also *Johannes Schroderus* writes that the meeting together of the Arteries in the Basis of the Heart, was in an heart degenerated into a bone.

Its Use. The Use thereof is, to communicate the Vital spirit, with the Nutritive Arterial blood, received from the heart, unto all parts of the Body, for Nutrition and life; which that it may not pass back again into the heart, Three

Its Valves. Valves are placed (like those in the vena Arteriosa exactly shut) looking from without inwards, which are termed Sigmiodes or Sigma-shap'd Valves.

Chap. VIII.

How the Vessels are united in the Heart of a Child in the Womb.

In the Child in the Womb. THe Vessels in the heart are otherwise disposed when the Child is in the Womb, then they are after it is born; which though *Galen* knew and made mention thereof; yet the greatest part of Anatomists have either neglected the same, or have delivered falsities thereabout, by saying that the Unions of the vessels were some of them only made by a Chanel, others only by way of Anastomosis.

The Union of the Vessels of the Heart. But the Conjunctions or Unions *of the* Vessels of the Heart in a Child in the Womb, are twofold:

One is made by an *Anastomosis*, another by a Chanel.

By *Anastomosis* an Union is made of the Vena Cava and the Arteria Venosa, under the right Earlet, near the Coronaria, before the Cava doth absolutely open it self into the right Ventricle. The hole is large and of an Oval Figure.

Now Nature contrived this Union by way of Anastomosis, 1. By reason of Vicinity. 2. Because of the likeness of substances.

Before this hole in the Cavity of Arteria venosa is placed a Pendulous, thin, hard, little Membrane, larger then the hole.

Its various Uses. Its Use is, 1. According to the Doctrin of *Galen* and his Clients, that the blood may be carried through this hole, out of the Cava into the Arteria venosa (not into the right ventricle, for vital spirit is not yet bred, nor do the Lungs need blood so attenuated) to nourish the Lungs; because they could not otherwise be nourished in a Child in the Womb, because in it the heart hath no motion whereby the blood might be forced out of the right ventricle into the vena Arteriosa: And therefore this Arteria venosa, is a vein in the Child in the Womb. But that it serves the turn of the Heart, and not only to nourish the Lungs, divers things *Evince* observed by the favorers of the Circular Motion. For 1. The Heart is moved even in an imperfect Child, after the third moneth, as Egs and Embryo's do testifie. But before the third moneth only a little Bladder of the Earlet pants, as in Insects before the Heart is perfectly hollowed. But this motion were in vain, if the Heart should not receive or expel any thing. 2. The blood by the Anastomosis is immediately poured into the left Ear, and is necessarily thence conveighed by the Systole of the Heart, into the left ventricle. 3. All the blood is carried through these Unions, doubtless not for the sake of the Lungs alone, which might be nourished after the same manner as in grown persons, although void of motion, the veins in part gaping. 4. The Child in the Womb is nourished with Arterial blood, which can come from no place but the Heart, as shall be demonstrated hereafter. Therefore,

II. The true use is, that it might conveigh part of the blood in a Child in the Womb, out of the Cava of the Liver, into the left ventricle of the Heart, which cannot go thither the ordinary way, the Lungs neither dilating themselves nor Respireing. In which passage the right ventricle also draws somwhat to it self.

And

The use of the little Membrane.

And that the blood may not slide back into the Cava, a little Membrane there placed hinders, when it fals in and settles.

'Tis shut after the Birth.

A little while after the Birth this Hole grows together and is dried up; so that a man would think the place had never been perforated, and that by reason of the plenty of blood in a grown person, forced out of the Lungs now opened and inlarged directly to the left Arlet, which suffers not a smal quantity of blood to flow out of the Anastomosis, whereupon being shut it grows together. Howbeit in grown persons, it remains for a season open. *Pinæus* observed it thrice, *Riolanus* once, and my self more then once. *Botallus* most frequently in Calves, Sows. Dogs of a large size, and therefore he would have it to be alwaies and naturally open, that blood might pass this way out of the right to the left Ventricle. *Cæcilius Folius* treading in his Foot-steps, thinks it is open in all Men, to the same end, as in a Child in the Womb, but contrary to experience. For it is then only open, when Nature hath shut up other passages, as I saw at *Padua* in that old Man, whose Arteria venosa was stopped with Flegm. In Water-fowl and other Animals that live in the Water, as Ducks, Castors, Swans, Bitturns, &c. it is alwaies open, because they live now and then in the Water, without the Use of their Lungs. And I have somtimes observed in dead bodies the little Membrane winking, and receiving the Probe without any violence, but I cannot allow that it is so alwaies. And that light opening would be unprofitable. For the passage of so much blood.

By a Chanel or Pipe.

Another Union is by a longish Channel, viz. that of the vena Arterialis, and the Arteria Magna, because they are distant one from another.

This Union is without the Heart (the other within the same) two Fingers from the Basis, in grown persons four, for the Channel doth not begin from the stock of the Arteria Magna. It goes obliquely to the Arteriosa (therefore no valve is annexed to it because the crookedness was able to hinder the Egress) [or rather because the blood is forced thither, from the right ventricle of the Heart through the vena Arteriosa but it is not in like manner driven back out of the left,

The Explication of the FIGURES.

In this TABLE are presented the Unions of the Vessels of the Heart in a Child in the Womb, also the Heart incompast with the Lungs, and the smal twigs of the Wesand or Wind-pipe call'd *Aspera Arteria.*

FIG. I.

A. *The Heart.*
B. *The Ascendent Trunk of Vena Cava.*
C. *The Descendent Trunk thereof.*
D. *The Ascendent Trunk of Arteria Magna.*
e. *The Axillary Artery.*
f. *The Descendent Trunk of the great Artery.*
g. *The Earlet of the right Ventricle.*
K. *An Anastomosis as it appears in Vena Cava.*

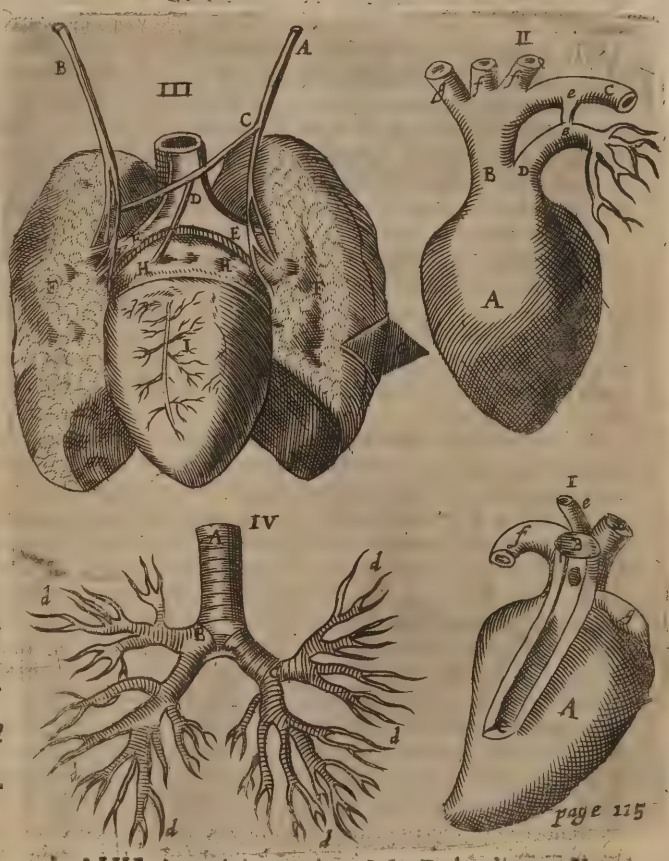
FIG. II.

A. *The little Heart of a Child in the Womb.*
B. *The Trunk of the Arteria Magna, springing out of the Heart.*
C. *A Portion of the said Artery going down-wards.*
D. *The Vena Arteriosa drawn out of the Heart.*
ee. *The Channel between the Vena Arteriosa and Arteria Magna.*
ff. *The Rise of the Arteries termed* Carotides *or drousie Arteries.*
g. *The beginning of the Subclavian right Artery.*

FIG. III.

A. *The right Nerve of the sixt Pare going towards the Lungs.*
B. *The same Nerve on the left side.*
C. *The middle Branch between the two Nerves.*
D. *The Off-spring thereof, which is carried to the Pericardium.*
EE. *The two greater Branches of Aspera Arteria, which on the back-sides are Membranous.*
FF. *The hinder part of the Lungs.*
G. *The proper Membrane of the Lungs.*

The VII. TABLE.



HH. *A remaining portion of the Pericardium or Hearts bag.*
I. *The Heart in its proper place.*

FIG. IV.

A. *The Aspera Arteria or Wesand, cut off under the Larynx.*
B. *Its right Branch, divided first into two.*
C. *The left Branch of the Arteria Aspera, distributed in like manner into greater and lesser Branches.*
ddd. *The Extremities of the Branches,*

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by

by the Arteria venosa] where it is divided into two, as if it had three parts; the least whereof notwithstanding is the Channel.

Which is dried up. In Infants of three or four years old, it is stil to be seen, but without any through-passage: in grown persons tis by little and little attenuated and dried, being distitute of all Nutriment, because no Humors pass any longer through the same, until through absence of Life and Nourishment, it Putrifies and Consumes quite away.

Its use. The *use* thereof is, I. According to the Mind of *Galen*, that the vital Spirit being received from the Navil-Arteries into the Arteria Magna, may from hence be carried, through that Channel into the vena Arteriosa and so straight into the Lungs, to maintain Life. But, 1. It serves not the Lungs alone. 2. The Navil-Arteries do bring out of the Arteria Magna, but carry nothing thereinto. 3. The Pipe is greater then to serve only to carry Spirits. 4. The Lungs of a Child in the Womb being red, are not nourished only with Spirits.

II. According to *Petrejus* and *Hofmannus*, to bring Arterial blood to nourish the Lungs. Who had said well, if they had not omitted the good of the whole body.

III. According to late Writers, that the blood which slides out of the upper Trunk of Cava into the right ventricle may pass through this Pipe, the greatest part thereof indeed to the Aorta, that so with the rest it may nourish and enliven the whole body of the Embryo; but the least portion of all goes up to the Lungs by the ordinary way.

Both the ventricles in the Child perform one and the same thing, and part the blood which is to be carried, because the more perfect blood is supplied by the Mother, and therefore the Walls are a like thick. And the two ventricles in the Child which doth not respire, perform the same, which in imperfect Animals void of Lungs, is accomplished by one ventricle.

This Pipe therefore assists the Anastomosis in transporting the blood of the Heart, because either of the waies would otherwise be two narrow. For I have observed in a Girle new Borne, by me publickly dissected, that the Pipe was wanting, because the Anastomosis was larger then ordinary: and there is reason for it. The Lungs must be nourished and the whole body must be nourished. Which can never be effected, unless the Arterial Blood be distributed out of the Aorta. It comes not from the Mother through the Iliack Arteries, because they are not joyned to the Arteries of the Womb, besides their motion is contrary, as the binding of the Navil Arteries doth shew. For the Navil-Arteries derived from the Child, do swel towards the Heart thereof, and towards the Placenta or Womb-cake they are empty; for the Arterial blood in the Child. after it is nourished, runs back through the Iliack veins to the Placenta, as a part of the Child which must be nourished, out of which it passes again into the Navil-veins, and is mixed with that other blood which comes out of the veins of the Womb, and runs joyntly back again to the Liver and Heart of the Child, that the Circulation may be repeated. Now it flows conveniently out of this vena Arteriosa through the Pipe or Channel into the Aorta, by reason of its Situation downwards, and its crooked insertion into the Aorta. Therefore seeing the Arterial blood, is not carried from the Mother, upwards to the Heart, neither can the Lungs be nourished thereby.

Chap. IX.
Touching the Lungs.

The Reason of their Name. THe Lungs called in Latin *Pulmones* in Greek *Pneumones* or *Pleumones*, have their name from Respiration or drawing in and blowing out the Air: because they are given to Animals living in their Air and breathing, but not to fishes which have neither Neck nor Voice.

Their Situation. They are seated in the Cavity of the Breast or Chest, which they fil, when they are distended.

Division. They are divided into the right and left part by means of the Mediastinum: that one part being hurt, the other may yet perform the Office.

Into Lobes. Each of these parts is divided into two Lobes, Laps or Scollups, about the fourth Vertebra of the Chest, of which the upper is shorter then the lower; seldom is one part divided into three Lobes, as in Brutes; because a man goes bolt upright, Brutes looking downwards, nor by reason of the shortness of the Chest, could any thing lie between the Heart and the Liver, except the Midrif. Yet oftentimes *Piccolhomineus*, *Riolanus* and my self, have after *Hippocrates* and *Ruffus Ephesius* observed three. Now the Lungs embrace the Heart with their Scollups as with certain Fingers.

Their Figure. Their shape resembles that of an Ox-hoofe. On the outside towards the Cavity of the Chest, the Lungs are Bossie or bunching out, on the inside they are hollow, where they embrace the Heart.

Their Colour. Their *Colour* in the Child is red like that of the Liver: by reason of the nourishment is receives from its Mother; in grown persons tis yellowish Pale; somtime Ash-color'd: in such as have died of a long sickness blackish. In some persons healthy enough. I have seen them Party colored, like Marble. In that part where it is knit unto the Chest by Fibres, tis red, as in a Child in the Womb.

Connexion. Tis *Knit* in the Fore-part to the Breast-bone by the Mediastinum, behind to the Vertebra's; somtimes the Lungs at the sides grow to the Pleura by certain Fibrous bands, whence arises a lasting shortness of Breath. Now this Connexion doth frequently deceive Physitians, not knowing or discerning Penetrating wounds of the Chest. *Nicolas Massa* conceives this Connexion profitable to the Heart, least it should be oppressed with the bulk of the Lungs, or the facility of breathing should be hindred, and *Riolanus* saies he evermore found this adhesion. I have cheifly observed it about the lower Ribs, near the Diaphragma, least they should press and bear upon it. Others say the Lungs are bound to Fibres, that in the wounds of the Chest, they might follow the motion of the Chest, though with a weaker motion.

A certain Cause of long lasting Short-windedness. *Hippocrates* in his second Book *de Morbis* calls it the Lungs slipt down to the side; and this comes to pass either from ones Birth, or after a Pleurisie, or by reason of Tenacious and clammy flegm interposing it self; or from some external cause, as negligent

Curing

Curing of a wounded or ſuppurated Cheſt. Alſo the Lungs cleave to the Heart, by the Vena arterioſa and the Arteria venoſa.

The Subſtance. The *Subſtance* in a Child in the Womb is compact and thick; ſo that being caſt into Water it ſinks, which the Lungs of grown perſons will not do. But after the Birth, becauſe it begins to be moved with the Heart, by heat and motion the Heart becomes light and ſoft, lax, rare and ſpungy; ſo that the Lungs will be eaſily raiſed and fall again, and eaſily receive the Air: Which may be ſeen by the uſe of a Pare of bellows in dead bodies. *Helmont* hath ſeen the Lungs hard and ſtoney, in an Aſthmatical perſon, and *Salmuth* obſerves that little ſtones have been there generated in ſhortneſs of Breath. Alſo touching ſtones we have the Teſtimony of *Galen, Trallianus, Ægineta.*

Membrane. The Lungs are compaſſed with a thin light Membrane, furniſht with many Pores which Pores are ſufficiently viſible, when the Lungs are blown up with a pair of bellows, and *Joh. Walæus* hath obſerved the ſaid Pores in live Anatomies, as big as a large Peaſe. This way the Sanies or Corrupt matter of the Cheſt may Penetrate and come away by Coughing. This Membrane is produced from the encompaſſing Pleura. For when the Veſſels enter into the Lungs, they deveſt themſelves of their Coat, which grows out of the Pleura, which doth afterwards inveſt the Lungs.

The Veſſels. The *Veſſels.* The Subſtance of the Lungs is interwoven with three ſorts of Veſſels, which make not a little alſo for ſtrength. Two proceed from the Heart, of which before: The *Vena Arterialis* and *Arteria Venalis.*

The third is proper, *viz.* The *Trachea* or Aſpera arteria ſo called, of which in the following Chapter.

If theſe Veſſels be fretted aſunder as in perſons *Phtiſical*, or having the Conſumption of the Lungs, many times plenty of blood is caſt forth, or ſome Cartilaginous ſubſtance; yea and the Veſſels themſelves of the Lungs intire, which I have ſeen, and *Tulpius* hath two examples. And oftentimes perſons in a Conſumption die ſuddenly, becauſe the greater Veſſels being fretted aſunder, the Heart is ſtrangled with blood iſſuing there from.

Why the Lungs hath ſo great Veſſels? Theſe Veſſels of the Lungs are great, not ſo much becauſe they wanted much blood, for their ſubſtance is very ſmal, ſetting aſide the Veſſels, nor needed they ſo much blood as is ſufficient to nouriſh the whole body; but they are great, becauſe the greateſt portion of the blood is carryed this way out of the right Ventricle of the Heart into the left by thoſe wide paſſages, for the more ſubtile blood can find its way through the obſcure Pores of the Septum. This paſſage is proved.

1. By the greatneſs of the veſſels. For the vena arterioſa and the arteria venoſa are moſt large. And becauſe the former is a veſſel which carries out of the Heart, it is furniſhed with the Mitre-faſhion'd valves, which hinder the blood from paſſing out of the Lungs the ſame way; and the latter bringing blood out of the Lungs into the Heart, has the treble-pointed valves, hindring the blood from returning.

2. Great Quantity of Blood is continually ſent by the Pulſe of the Heart, through the vena arterioſa and thence through the arteria venoſa unto the left ventricle, which is further confirmed by Ocular Inſpection.

3. By Ligatures in living Anatomies. For the Vena arterioſa ſwels towards the Heart; but near the Lungs it is empty; the Arteria venoſa contrarywiſe, ſwels towards the Lungs, but is empty towards the Heart. *See Tab. 4. of Book 2.*

4. The left Ventricle of the Heart being wounded, or the Arteria aorta, great plenty of blood will iſſue, as long as life remains, till all the blood in the body be run out. And from what other place can it come, ſeeing ſo much is not contained in the Heart, but out of the Lungs through the Arteria venoſa, which had drawn the Blood out of the Vena arterioſa by the Anaſtomoſes.

5. In the Arteria venoſa as well of a living as a dead Body, ſo much Blood is found, that it hath often hindred me in my publick Diſſections.

6. By the ſimilitude of the Veſſels one with anothet. The Vena arterioſa carrying out of the Heart into the Lungs, is juſt like the Aorta in ſubſtance, largeneſs, neighbourhood, and Valves. The Arteria venoſa doth in like manner reſemble the Vena cava by ſtraitneſs of Connexion, ſubſtance of a Vein, Earlets and treble-pointed Valves.

How Circulation is cauſed in the Lungs. This *Circulation* through the Lungs is *furthered*, 1. By the widening of the Lungs when Air is drawn in, which being every where filled, the veſſels are diſtended, as when they ceaſe, the motion of the Blood is either retarded, or quite ceaſes. 2. By the Situation of the veſſels of the Lungs. The Vena arterioſa is Diſſeminated in the hinder or Convex part of the Lungs, becauſe it is ſtrongly moved by the Pulſe of the Heart, the Arteria venoſa doth cheifly poſſeſs the foremore and hollow part, that the Blood might more readily ſlide into the Heart. In the Middeſt of which the Branches of the Wind-pipe are ſeated, that in the blowing out of the Air, they might receive ſooty Exhalations from the Vena arterioſa, and in drawing the Air in, they might communicate the ſame to the Arteria venoſa. 3. The anaſtomoſes, by which the veſſels are joyned together, both the branches which joyn mouth to mouth (though in dead bodies they cannot be diſcerned by the Eye-ſight) and the Pores of the Parenchyma which is light and Porous.

Contrary objections anſwered. It is to be noted for the anſwering the objections made againſt this Circulation.

1. That the Lungs are not oppreſſed or burthened ſo long as they being ſound, the Blood perpetually glides through by Peice-meal.

2. That the blood doth not drop out through the Pipes of the Weſand, becauſe partly they draw in only Air or ſooty Exhalations, and in no wiſe Blood of a thicker nature then they, unleſs they be preternaturally fretted in perſons that have the Conſumption, partly becauſe nature never ceaſes to drive ſound humors through the paſſages ordained for them, and retains what is neceſſary, which would otherwiſe go out at the paſſages of the Body being opened.

3. Although the Lungs of Dead bodies are whitiſh, yet the veſſels do manifeſtly tranſpire through the external Coat. The Parenchyma it ſelf is frequently ful, in perſons ſtrangled with blood, in others it is found emptied, becauſe in the Pangs of Death it is forcibly excluded.

4. In burning Feavers, both the Lungs are hot, and thereupon the voice is Hoarſe and dry, and they are oppreſſed, as appeared in the Epidemical Feaver

which raged up and down this year, by which many were strangled.

5. It is no good judging of the healthy state of the Body, from the preternatural state thereof.

Why Ulcers of the Lungs are without pain.

Very smal *Nervulets* from the sixth Pare are spred only through the Membrane thereof (which if it be inflamed, a pain will be felt, and communicated to the side it self and to the Back) not through the substance of the Lungs, least by Reason of their continual motion they should be pained. Hence the Ulcers of the Lungs are without pain. Howbeit *Riolanus* allots very many Nerves to the substance of the Lungs also, drawn from the Implication and Contexture of the Stomach Nerves. I also have seen many spred abroad within the Lungs, proceeding from the sixt Pare, and alwaies in a manner accompanying the Bronchia or Lung-pipes, derived from the hinder part, and only a little twig conveig'd to the Membrane from the forepart.

What the *Action* of the Lungs is, Authors Question. That they never move at all is *Helmonts* Paradox, but serve only as a seive, that the Air may pass pure into the Chest, and that the Muscles of the Belly alone do suffice for Respiration. But

Whence the motion of the Lungs proceeds.

that they are indeed and in truth moved, the cutting up of live bodies shews, and Wounds of the Chest, that they move long and strongly. Moreover that they may be moved, any one may try with a pair of Bellows. Finally, They ought to be moved, for otherwise both the Heart would be suffocated, and the motion of the blood in the Lungs, would be hindred. The Muscles of the Belly do indeed concur, but secondarily, because they are not joyned to the Heart, and when they are moved Respiration may be stopped, Yea, and when they are cut off in a living Anatomy, the Lungs are moved nevertheless. But whether they are moved by their own proper force, or by some other thing, is a further Question. *Averrhoes* who is followed among the late writers by *John Daniel Horstius*, conceives the Lungs are moved by their own proper force, not following the motion of the Chest, for otherwise saies he we must grant that a violent motion may be perpetual.

But we are to hold, that though the Lungs are the Vessel of Respiration, yet they are so not by doing, but by suffering. For they have no motive force of their own, as *Averrhoes* will have it (because at our pleasure we can stop our breathing, or quicken or retard the same) nor do they receive the principle of their motion from the Heart, or from the blood rai-

Aristotles Error.

sing them, as *Aristole* conceives, and his followers, For 1. The efflux of the blood out of the Heart, is made by the ornary motion, but the Respiration is voluntary. 2. The Cause of the Pulse and Respiration would be one and the same, and they would be performed at one and the same time. But thirty Pulses answer one Respiration. 3. While we draw in our Breath strongly, and hold the air drawn in for a season, the swelling of the Lungs should compel us to let our breath go, because it lifts up the Chest, according to their opinion. 4. The Blood of the Heart doth not abide in the Lungs by an unequal retention, so as to distend them, but it is forthwith expelled according to nature. 5. When it tarries longest in diseased Lungs, it makes shortness of Breath or difficulty in breathing, but no Tumor. 6. In a strong Apoplexy, the motion of the Lungs ceases, the Pulse being safe and the Heart unhurt.

The Opinion of Falcoburgius.

Nor are the Lungs raised up, by the air forced in, which when the Chest is lifted up, because it hath no other space whither it can go to, it is carried through the Aspera arteria or Wesand into the Lungs, as *Falcoburgius* and *Des Cartes* conceive, and *Hogelandius*, *Regius*, and *Prataeus* who follow him: For 1. The air may easily be condensed, as may be proved by a thousand experiments, as by Cupping-glasses, Weather-glasses, Whips, Trumpets, Winds and infinite things beside; and therefore it may be most straitly compacted about the Chest, and compressed within it self, as well by the internal subtile nature of the air and dispersed by Atomes, easily recollected one within another, as by the external impulse of the Chest, whereby it may more easily be condensed, then driven into another place. 2. By the motion of the Chest or such a like body, we do not see the lightest thing that is, Agitated. By an hole in a Wall all Chinks and Dores being closely stopped, our Nostrils being stopped, we may with our Mouthes draw air out of the next Chamber, to which it is not credible that the air moved by the Chest, can reach with a strong motion; and though air may penetrate into the Chamber, through some chinks and Rifts, yet is it not in so great quantity, as to stretch the Chest so much as it ought to be stretched, in free Respiration. The same experiment may be made in a Glass or Silver vessel applied close to ones Mouth. 4. While I have held my Breath, I have observed my Belly to be moved above twenty times the while. But whether is the Air then driven? Must it not needs be, because all places are ful of bodies, that the air next the Belly is compressed and condensed? See more of this subject in my *Vindiciae Anatomicae*, and in a peculiar *Discourse*.

Therefore the Lungs do only follow the motion of the Chest to avoid *Vacuum*: And therefore only they receive the air drawn in, because the Chest by widening it self, fils the Lungs with air.

The motion of the Lungs is proved to arise from the Chest.

Now that the Motion of the Lungs arises from the Chest experience shews. For 1. If air enter into the Chest, being peirced through with a Wound, the Lungs remain immoveable, because they cannot follow the widening of the Chest, the air insinuating it self through the wound, into the empty space. But the Chest being sound, the Lungs follow the widening thereof, to avoid Vacuum; as in Pipes, Water is drawn upwards, and Quittor, Bullets, Darts and other hard things are drawn out of body through the avoidance of Vacuum. 2. If the Midriff of a live Creature be peirced through with a light wound, Respiration is stopped, the Chest falling in.

An Observation in live Anatomies.

But somwhat there is which hinders many worthy men from assenting to this cause of the Lungs motion, because after the Chest is perfectly opened, the Lungs are oftentimes moved a long time, with a vehement motion. But according to the Observation of *Johannes Walaeus*, *Franciscus Sylvius*, and *Franciscus Vander Shagen*, that is not the motion of Constriction and Dilatation, which is the natural motion of the Lungs; but it is the motion of an whole Lobe upwards and downwards, which motion happens, because the Lungs are fasten'd to the Mediastinum, the Mediastinum to the Midriff, and the Lungs are also

seated

ſeated near the Midriff: whence it happens, while the Creature continues yet ſtrong, that either the Lungs with the Mediaſtinum are drawn, or by the Midriff driven, the Diaphragma or Midriff, not yet falling down nor looſing its motion, which I obſerve in contradiction to the moſt learned Son of *Horſtius*. Now that this motion proceeds not from the inbred force of the Lungs, doth hence appear, in that alwaies when the Cheſt is depreſſed, the Lungs are lifted up, being forced by the Midriff, which at that time riſes a good height into the Cheſt; and contrarywiſe the Cheſt being lifted up, the Lungs are depreſſed. And becauſe the Lungs are the Inſtrument of Reſpiration, Hence it hath theſe following,

Its Uſe. *Uſes*, I. According to *Plato*, *Galen*, and *Abenſinæ*, to be a ſoft Pillow and Cuſhion under the Heart.

II. According to others who follow *Columbus*, to prepare and wellnigh generate the vital Spirits (which are afterwards to receive their perfection in the heart) whiles in them the blood is as it were Circulated, firſt boyling with the heat of the Heart, and afterwards ſettled by the coldneſs of the air.

III. It hath more proper uſes when it is Dilated, and when it is contracted.

When the Lungs are Dilated, they receive in the Air like a pair of Bellows through the Branches of the Wind-pipe.

All kind of Air is not a friend to mans Spirit. I. To prepare Aire for the Heart, for the convenient nouriſhment of the lightful Spirit. For every quality of the Aire is not a friend to our Spirit, as is ſeen in ſuch as are kild with the ſmoak of Charcole, and the ſteam of newly whited Walls.

Helmont conceives that the Air is united to the ſpirit of the Heart, and that it receives a fermentation in the Heart, which accompanying the ſame they do both diſpoſe the Blood to a total tranſpiration of it ſelf, which is the reaſon why in the extremity of cold weather and at Sea, we eat more heartily, becauſe the thinneſs of the Air diſpoſes the blood to inſenſible tranſpiration. *Backius* is ſomwhat of the ſame mind, who conceives that by the moiſt and thin body of the Air, the blood is made apt to run, ſo as that it may be diffuſed into the ſmalleſt paſſages of the Body. Others aſcribe both theſe effects to the abundance of Seroſity in the Blood. Therefore *Hippocrates* ſaies that water is hungry; and we ſee that ſuch as are given to drink, are enclined to ſweat much, as alſo Scorbutick perſons.

Our heat doth want a Cooler. II. To fan and cool the heat. For we ſee that the heat of our Bodies ſtands in need of ſomwhat that is cold, without which it is extinguiſhed, as is apparent in ſuch as ſtay long in very hot Baths, as the flame of a Candle in a cloſe place, wanting Air goes out. And therefore the Lungs are called the Fan and cooler of the Heart, and the Fiſhes in the Water and other Animals that have but on Ventricle in their Hearts, are without Lungs, becauſe they do not want ſuch a cooling. As alſo Infants in the Womb, being fanned by their Mother, and the wide Anaſtomoſes, have their Lungs without motion. Hence it is that having ſeen only the Lungs, you may judg how hot any Creature is; for Nature makes the Lungs the larger, by how much the Heart is hotter. Therefore the Lungs are not abſolutely neceſſary to Life, but ſerve to accommodate the Heart. For inſtead of Lungs a boy of *Amſterdam* four years old, had a little Bladder ful of a Membranous wind, as *Nicolas Fontanus* a Phyſitian of that Citty doth teſtifie, which being guarded with very ſmal Veins, had its original from the Aſpera Arteria or Weſand it ſelf, whoſe office it is to cool the Heart. Who nevertheleſs died of a Conſumption, becauſe haply, his Heart was not furniſhed with a ſufficient quantity of Air.

Why Fiſhes need no Lungs.

The Lungs of Children in the Womb move not.

When the Lungs are contracted in Expiration, they do again afford us a twofold uſe. I. Sooty Excrements do paſs away through the ſame, being carried out of the Heart with the blood, through the Vena Arterioſa. II. To make an articulate voice in Men, and an inarticulate ſound in Beaſts, by affording Air to frame the voice. And therefore Creatures that have no Lungs, are mute, according to *Ariſtotle*.

Chap. X.

Of the Lung-Pipe or Weſand.

The Weſand. THe Pipe or Channel of the Lungs, is by the Ancients called *Arteria*, becauſe it contains Air: *Galen* and others call it *Trachea arteria* or the rough Artery, becauſe of its unevenneſs, and to difference it from the ſmooth Arteries. *Lactantius* terms it *Spiritualis Fiſtula*, the Spirit or Air-Pipe, becauſe the Air is breathed in and out thereby, Now it is a Pipe or Channel entring into the lower part of the Lungs, with many branches, which are by *Hippocrates* termed *Syringæ* and *Aortæ*, whoſe head is termed *Larynx*, of which in the following Chapter; the reſt of its Body is termed *Bronchus*, becauſe it is moiſtened with drink.

Why call'd Trachea *or Aſpera Arteria?*

Whether any part of our drink doth paſs into the Weſand and Lungs. For that ſome part of the drink doth paſs even into the Wind-pipe and Lungs, *Hippocrates* doth rightly prove by an Hog new kild, in whoſe Lungs matter is found juſt ſo colored as the drink was, which he drunk immediately before he was killed. And that ſome drink may be carried through the Wind-pipe, may be proved out of *Julius Jaſolinus* an Anatomiſt of Naples, who ſeeking in the body of a Noble perſon, the Cauſe of his death, found his Pericardium or Heart-bag, ſo diſtended with Humor, that it being ſqueezed, ſome of the ſaid Humor came out at his mouth.

Its Situation in Man-kind. As to its *Situation*: in Man-kind it reſts upon the Gullet, for it goes down from the mouth ſtraight along to the Lungs: and at the fourth Vertebra of the Cheſt, it is divided into two branches, each of which goes into the Lungs of its reſpective ſide: they are again ſubdivided into two other branches, and theſe again into others till at laſt they end into very ſmal twigs in the ſurface of the Lungs. But the branches thereof which are greater then the reſt of the Veſſels of the Lungs, entring into the Lungs, do go through the middle thereof, between the Vena Arterioſa which is hindermore, and the Arteria venoſa which is before it: with which it is joyned by obſcure Anaſtomoſes, or conjunctions of Mouths, hardly diſcernable by our Eyeſight.

In a Swan. In Bruits tis *Situate* much after the ſame manner.

manner. Yet we must note that it is different in a Swan, and after a manner altogether singular. For being longer, it insinuates it self by a crooked winding into a case of the Breast-bone, and soon after from the bottom of the case, it returns upwards, and having mounted the Channel-bones, it bends it self towards the Chest. But before it reaches the Lungs, tis propped by a certain boney Pipe, broad above, narrow beneath, which in a Duck is round, then it is divided into two branches, which swel in the middle, but grow smaller where they tend to the Lungs, till they enter into them.

Its Membranes. Tis cloathed with a double *Membrane*: one *External*, another *Internal*.

The *External* is a thin one arising from the Pleura, and sticks close to the intermediate Ligaments of the Gristles, and Ushers along the recurrent Nerves.

The *Internal* being furnished with straight Fibres is thicker and more solid (most of all in the Larynx, least of all in the branches of the Lungs, indifferently in the middle Pipe) to the end it may not easily be hurt by Acrimonious drinks, or other Liquors voided by Coughing, or falling down from the Head.

It *arises* from the Coat which compasses the Palate, and therefore is continued with the Mouth.

It is smeared with a *fat Humor* to hinder its being dried up by motions, loud cryings, drawing in of hot Air, going out of sharp sooty Exhalations, &c. And by the Superaboundance or Deficiency hereof the Voice is hurt. *The Voice hurt.* For in the former contracted by Distillations, it becomes Hoarse; in the latter through burning Feavers, &c. It becomes squeaking. If it overabound, we are quite Dumb and unable to speak, and the moisture being consumed our Speech returns again: which might happen in that same dumb Son of *Cræsus* mentioned by *Herodotus*, and in *Ægle* a Samian wrastler, mentioned by *Valerius Maximus*, and *Zacharias Orphanus* a Fool, of whom *Nicolas Fontanus* tels a story in his Observations.

This Coat is of exquisite sense, that it may raise it self to expel what ever is trouble-some thereunto.

Between these two Membranes is the proper *substance* of the Trachea arteria, which is partly of the nature of a *Gristle*, and partly of a *Ligament*.

The FIGURES Explained.

This TABLE represents the Aspera Arteria, the Oesophagus, the recurrent Nerves about the Arteria Magna and the Arteria Axillaris, behind

FIG. I.

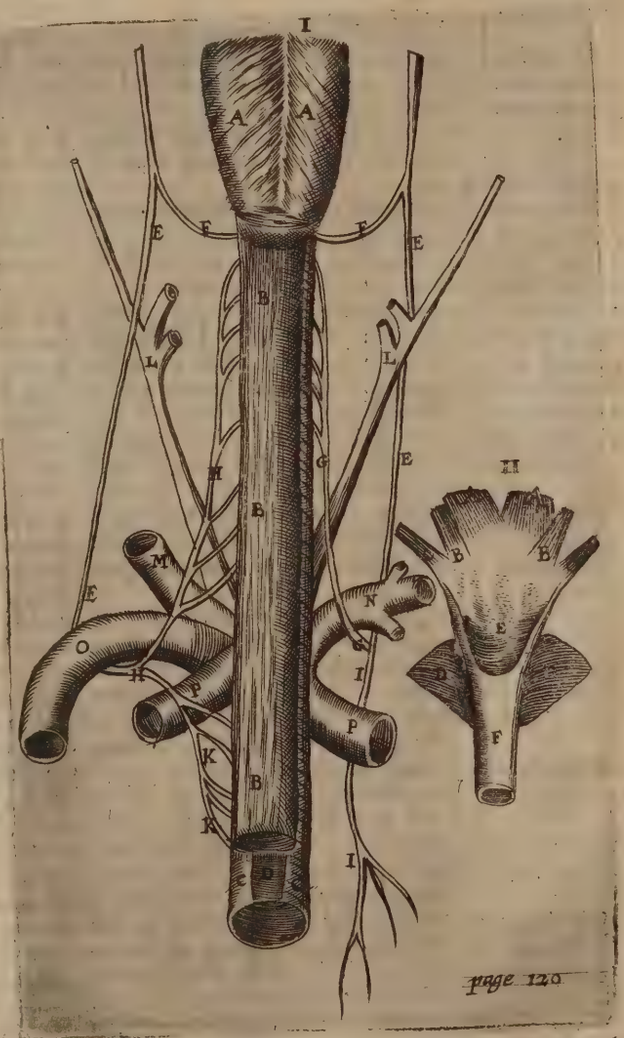
AA. *The Muscle contracting the Oesophagus.*
BBB. *The Oesophagus or Gullet.*
CCC. *The Aspera arteria or Wesand placed under the Throate.*
D. *The Membrane between the Wesand and the Gullet.*
EEEE. *The Nerves of the sixth Conjugation.*
FF. *Nerves of the Tongue inserted behind.*
GG. *The right recurrent Nerve, turned back to the Artery of the Shoulder.*
HH. *The left recurrent Nerve about the Descendent Trunk of the Arteria Magna.*
II. *A Nerve tending to the left Orifice of the Stomach and to the Diaphragma.*
KK. *A Nerve descending to the Diaphragma.*
L. *The jugular Arteries on each side one.*
M. *The left humeral Artery.*
N. *The right Humeral or Shoulder Artery.*
OO. *The Arteria Magna or great Artery.*
PP. *The Trunks of the Arteries descending to the Lungs.*

FIG. II.

This Figure shews the upper part of the Gullet with its Muscles.

AA. *The* Musculi Cephalo-pharyngæi *so called.*
BB. *The* Musculi Spheno-pharyngæi.
CC. *The* Musculi Stylopharyngæi.
DD. *The Sphincter drawn from the Gullet.*
E. *The Inside of the Gullet.*
F. *The Descending part of the Gullet.*

The VIII. TABLE.



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I. For

Why the Wesand is in part Gristly?

I. For the Voices sake: because that which makes a sound must be solid.

II. Otherwise by reason of its softness it would alwaies fall together, and would not easily be opened in Respiration.

Why in part Ligamental.

It was to be partly *Ligamental*, and not wholly of a Gristly substance: for if it should consist of one only Gristle, or many circular ones,

I. It would be evermore open, and not somtimes widen and then fall together.

II. It would bear hard upon the Gullet, to which nevertheless, it ought to give way, especially in the swallowing down of solid meats, that the Throat or Gullet might be sufficiently widned. And so the Gristles help to frame the Voice; and the Membranous Ligaments for Respiration.

The *Gristles* are many, round like Rings, but not exactly. For on their backside, where they touch the Gullet, a fourth part of a circle is wanting, in place whereof there is a Membranous substance.

From their shape they are termed *Sigma-shap'd* resembling the old Greek letter C, til they are fixed in the Lungs, for then changing their Fignre, they change their name. For the Wind-Pipes do there consist of perfect Gristles, Round, four square, or Triangular, but where they are joyned to the rest of the Vessels of the Lungs they become Membranous.

These Gristles are joyned together by Ligaments going between, which in Men are more fleshy, in brute Beasts more Membranous; and in men the shew like little Muscles. And the Gristles do every where keep an equal distance one from another, and the higher, the greater they are.

It hath *Vessels* common with others. *Veins* from the the external Jugulars; *Arteries* from the Carotides; Nerves, from the Recurrent Nerves of the sixth pair.

The Use of the Wesand.

Its *Use* is, I. In drawing in the Air, that by it as a Pipe, the Air may be received from the Lungs, as from a pair of Bellows. Hence comes that same Wheezing in such as have the Tiffick, the Pipes of the Wesand being stopped, so that the Air coming and going and not finding a free passage makes that Hissing noise.

II. In blowing the Air out, 1. That through it Fuliginous Excrements may be voided at the Mouth and Nostrils. For which intent the mouths of the Vena arteriosa do so artificially joyn with the Mouths of the Aspera arteria, that there is passage only for sooty steams but not for blood, unless it come away by force and violent Coughing. In the next place, that it may help to form the voice, which it doth by expiration likewise, though some Juglers frame their Voice by inspiration only or drawing in of their Breath. And therefore *Hippocrates* calls it the breathing and vocal Organ. A wonder therefore it is that some Men can live long in the Water like Fishes, by Nature and not by Art, if *Cardan* is to be believed in the second Book *de Subtilitate*, when he makes relation of one *Calanus* a Diver in *Sicily*, who would lie three or four hours under the Water. And how in the *West-indies* everywhere, such as dive for Pearl-oysters, will lie an hour together under the Water. If they did this by some art, it were not so wonderful. So the Ægyptians are most perfect divers, and exercise Robberies that way. For as appears by the Description of *Nicolas Christophori Radzivilij* his journey to *Hierusalem*, they lie lurking under the Waters, and not being content to steal on land, what ever they can catch they draw into the water, and carry it away: and frequently they catch a man as he lies upon a Ships deck draw him under the water and kill and strip him of his cloathes: So that such as sail are said many times to watch all night armed, And in the same parts, aboundance of fisher men will dive under the water and catch fish with their hands, and they will come up with a fish in each Hand and a third in their mouths. These persons doubtless, do either live only by Transpiration, as such do that have fits of the Apoplexy and the Mother; or they have Anastomoses open in their Hearts, by means of which as in the Womb, the blood is freely moved, without any motion of the Lungs.

Chap. XI. *Of the Larynx.*

The Larynx.

THe Head or beginning of this Lung-Pipe, is termed Larynx, which is the voices Organ.

Its Situation.

Tis *Situate* in the Neck, and that in the middle thereof, for it is

Number.

In *Number* one, that there may be only one voice.

Shape.

Its *Figure* is round and almost circular; because it was to be hollow for the voices sake; but on the foreside it is more Extuberant, on the hinder side depressed, that it may give way to the Gullet, especially in the time of swallowing, in which while the *Oesophagus* is depressed, the *Larynx* runs back upwards, and so assists the swallowing, both by giving way and bearing down that which is to be swallowed.

Magnitude.

Its *Magnitude* varies according to the Ages of persons. For in younger persons the Larynx is strait which makes their voice shril: in grown persons tis wider, and therefore their voice is bigger. To which also the length or shortness of the Larynx doth contribute: and if plenty of Air or Spirit be drawn and expelled, the Voice becomes big; if little, it becomes small.

How the voice becomes shril, or big?

What the Causes are of a great Voice?

And therefore according to *Galen* there are two causes of a great Voice: the Largeness of the Aspera arteria, and the strong blowing out of the air, and *Hippocrates* saies both these are caused by great heat. And therefore in his Book of the *Seed*, he teaches us that the stones do contribute to the formation of the Voice, Hence Males when they grow of ripe years change their voice. A Guelded Horse looses his neighing. A Capon leaves his crowing or crows after a weaker fashion, different from his former crowing.

How the Voice comes to change.

The Parts of the Larynx or about the Larynx: are *Gristles*, *Muscles*, *Membranes*, *Vessels* and *Kernels*.

Its Muscles.

Its *Muscles* do first of all offer themselves, which move the Gristles, which the Larynx is possest of, that it may be moved with a voluntary motion, seeing we utter our Speech, as we please our selves.

Now the *Muscles* of a Mans Larynx, are but thirteen, four common and nine proper: though some make twenty, other eighteen, others fourteen.

The FIGURES Explained.

This TABLE Represents the Larynx, with its Muscles and Gristles.

FIG. I.

A. *The Gristle cal'd* Shyroides *or Scutiformis, Sheild-fashioned.*

BBBB. *A Pair of common Muscles called* Sternothyroides.

CC. *Another pair of common Muscles called* Hyothyroides.

FIG. II.

A. *The Epiglottis lying yet hid under the Scutiformis.*

B. *The Scutiformis or Sheild-fashion'd Gristle.*

CC. *Its Process.*

DD. *Two Muscles proper to the Larynx, of which that on the left Hand is removed from its place, that the Ring-fashion'd Gristle* E. *may be seen.*

F. *The Extuberancy of the Ring-fashion'd Gristle, or Cartilago Annularis.*

G. *A portion of the Aspera Arteria.*

FIG. III.

AAA. *The Bone Hyoides with three Extuberancies.*

B. *The Epiglottis.*

CC. *The Sheild-fashion'd Gristle, hollow on the Back-side.*

DD. *The two Muscles cal'd* Cucullares, *or the hinder pair of the* Cricoarythenoides *so called.*

E. *The hinder and Membranous part of the Aspera Arteria.*

FF. *The Muscles cal'd* Arytenoides, *by some the ninth pair.*

FIG. IV.

A. *The Concave part of Cartilago Scutiformis dilated.*

B. *The third pair of proper Muscles cal'd* Cricoarythenoides laterale.

C. *The first pair of proper Muscles.*

D. *The fourth pair cal'd* Thyroarythenoides internum.

EE. *Insertion of the recurrent Nerve.*

FF. *The hinder and Membranous part of the Aspera Arteria.*

The IX. TABLE.

FIG. V.

AA. *The Cartilago Thyroides or Scutiformis.*

BB. *The inferior processes thereof.*

C. *Its Concave Part.*

FIG. VI.

A. *The inside of the Cartilago Annularis.*

B. *Its lower and fore-side.*

C. *Its hinder and upper-side.*

FIG. VII.

A. B. *The Cartilago Arythenoides according to its hinder side joyned, as yet to the Annularis.*

C. *The broader and Back-part of the Annularis.*

FIG. VIII. IX.

Shews the Gristles which constitute the Arythenoides, Separate from the Annularis.

The Common. | The *Common* are those which are implanted into the Larynx, and yet do not arise therefrom.

The Proper. | The *Proper* have both their original and termination in the Larynx.

The *first pair* of the common, called by the Ancient *Sternothyroides*, being lower more, arises within from the Breast-bone, its original being broad and fleshy, and going a long by the Wezand, it is inserted beneath into the sides of the Sheild-fashion'd Gristle.

Its *Use* is to straiten the Chink of the Larynx, by drawing down the Scutiformis.

The *second Pair* called *Hyothyroides*, being the uppermore, arises from the lower side of the *Os hyoides*, being broad and fleshy, and touches the Scutiformis, being implanted into the Basis of the said Scutiformis.

Its *Use* is to widen the Chink, by lifting up the Scutiformis,

Spigelius and *Vesslingius* assign contrary offices to these: for they will have the first pair to widen and the second to straiten the Chink of the Larynx.

Others do here add a *third pair*, which *Columbus* nevertheless and *Casserius* do account but one Muscle.

But

But this is rather *Musculus Deglutitorius*, or a Swallowing muscle, because arising from the Scutiformis tis wrapped about the Gullet.

It is judged, by contracting the sides of the Scutiformis, to straiten the Chink: but it is no Servant to the Larynx unless by accident.

The Proper. The *first proper Pair*, arises on the foreside, from the lowest part of the Scutiformis, as the Insertion of the Nerves doth shew, and ends at the *Annularis*. And therefore this pair may be termed *Thyrocricoides*; but not, as most Anatomists will have it, *Cricothyroides*. *Some* will have it to arise from the fore-side of the *Cricoides*, and to end into the lowest side of the Scutiformis. If it be broad and spred out side-waies, it may be divided into two pair, the *foremore* and the *side pair*, and so *Riolanus* divides it. But it is for the most part single and smal enough.

Its *Use* is to draw the Cartilago Annularis to the Scutiformis (lightly, because it is almost immoveable) so that they may be joyned together, and kept in that posture. Others who differ about its original, will have it to widen the Chink or the Scutiformis.

The *second Pair* rises from the back side of the Annularis, with a fleshy orignal, and is implanted into the lower part of the *Glottalis* or *Arytænoides*, with a Nervous end, opening the Larynx, by drawing asunder the two Gristles called *Arytænoides*. And therefore they are called *Par Cricoarythenoides posticum*. *Casserius* cals them *Par Cucullare*.

The *third pair*, *Cricoarythenoides laterale*, arises above from the sides of the Annularis, and is inserted at the sides of the *Glottalis*, into the joynt, there where it is not touched by the former, and opens the Larynx, with the same oblique carriage of the Gristles.

The fourth pair, called *Thyroarytenoides*, being inward and very broad, proceeds from the Scutiformis, viz. from its inner and fore part, and from the *Cricoides* likewise, as *Riolanus* suspects, and ends into the sides of the *Glottalis*, or the *Arytænoides*, which while it contracts and draws to the *Thyroides*, it shuts the Larynx, by a straight passage. When this pair is inflamed in a Squinsie, it makes the Disease deadly, because it exactly shuts the Chink.

The *ninth Muscle*, which others term *Quintum par Arytenoides*, arises from the hinder line of the *Guttalis*, and being carried along with transverse Fibres, it is inserted into the sides thereof, shutting the Larynx, while it straitens the Cartilago *Arytænoides*.

For *it is to be noted*, that all the proper Muscles of the Larynx, are ordained either to contract or widen the Chink, which that it may be the more conveniently accomplished, some of them widen and straiten the *Thyroides*, others the *Arytænoides*, which Gristles do compass the Chink, which being drawn in, or widened, the Chink is withal made narrower or wider. Whence it appears, that I have not unskillfully propounded the Muscles of the Larynx, as *Riolanus* upbraides me.

The *Epiglottis* in Mankind has no Muscle; for it is not voluntarily moved in Men, as some vainly perswade themselves; but is only depressed by the weight of such things as are swallowed.

But in brute Beasts, the *Epiglottis* bath Muscles, because they are continually eating, and chewing the Cud, and they have a very great *Epiglottis*. And in them some Muscles arise from the *Hyoides*, and are implanted into the Basis of the *Epiglottis*, which they lift up; (and this pair *Vesalius* reckons to be the fift common pair) and others are seated between the Coat of the *Epiglottis* and the Cartilage, shutting the same.

Its Gristles. The *Gristles* of the Larynx *are five*: which in elderly persons do somtimes attain a boney hardness; by means whereof, some have scaped the danger of suffocation, when they hung upon the Gallows.

The *first Gristle* is termed *Cartilago Thyroides*, or *Scutiformis*, *Scutalis*, *Clypealis*, *Peltalis*, &c. from its shape; because it resembles a sheild, being in a manner four-square, hollow within, Bossie and bunching without, but more in Men then in Women: because their Necks are made even, for beauties sake, by those Kernels placed by the Larynx. That same bunch which is seen on the foreside of the Neck, is called *Adams Apple*, because the common people have a beleise, that by the judgment of God, a part of that fatal Apple, abode sticking in *Adams* Throat, and is so communicated to his posterity. It is distinguished in the middle with a line, and therefore some have made it double, whereas in truth it is very rately found otherwise then single.

Adams Apple is more bunching out in Men then in Women.

In its Corners it hath *processes*, above two long ones, wherewith by help of a Ligament, it is joyned to the lower sides of *Os hyoides*; and beneath two likewise, by which tis joyned to the following Gristle.

The *second* is the *Cricoeides* or Annularis, because it is round like a Ring, and compasses the whole Larynx. Now it resembles the Turkes Ring, wherewith they Arm their Thumbs when they shoot, for the hinder part is broad and very thick. The fore part is straiter and drawn in like one of our Rings. Tis vulgarly termed *Innominata*, or the nameless Gristle, because the ancients gave it no name. Tis the Basis of the rest of the Gristles, by help whereof they are joyned to the Aspera Artera, and therefore it is immoveable.

The *third* and *fourth*, which others count for one, when the Membrane is taken of, appears to be double. Tis called *Arutainoeides*, *Guttalis*, by reason of its resembling the spout of an Ewer, whereout the Water is poured, if the two processes of the upper part are considered, which being joyned together do make up that little Chink which modulates the voice, which others terme *Lingula*, *Parva Lingua*, or *Glottis*, the little Tongue, for the voice cannot be framed but through a narrow passage. This rests upon the upper and hinder side of the *Cricoides*, in the Cavity of the *Thyroides*.

The Glottis.

In this place is to be observed a certain *Hollowness*, which is formed between the Guttalis and the Scutalis, by the Membranes which gather up the Cartilages; into which if peradventure while one is speaking or laughing, and the *Epiglottis* is open, a crum of bread or a drop of drink do happen to fall, it causes Coughing, because it goes against the Course of the wind. But if any thing slide leasurely down the Chink, by the Walls of the Larynx, it hinders not the wind, and so causes no Coughing.

Epiglottis. The *fift* is termed *Epiglottis*, which covers and shuts the Chink, least an considerable quantity of meat or drink should fall into the Wesand, but that the *Epiglottis* being shut, they might pass down the Gullet. But it is not exactly shut, so that some smal quantity of drink may slip down the sides. For when we say that drink passes

not

not into the Weſand and the Lungs, it is to be underſtood of the greateſt part; for that ſome is carried thither, I have ſhewed you before. And therefore in Diſeaſes of the Cheſt, we preſcribe Electuaries and Lozenges, which are to be held in the patients mouth, his Head leaning backwards, till they melt away, that ſome portion of them may ſlip in by the Walls of the Weſand. Tis opened when we Laugh, and therefore Men muſt be careful that they do not Laugh when they are ſupping of broath, or the like. Alſo let ſuch as are greedy eaters take heed leaſt, any meat get between the *Epiglottis* and the Chink, whence immediately ſuffocation follows, as I have ſeen in a yong man of *Hafnia*, who was ſuddainly choaked by a peice of Neats-tongue weighing an ounce and an half, greedily eaten.

Now the *Subſtance* of the *Epiglottis* is ſoft, and its *Shape* reſembles a Tongue, or an Ivie leaf, according to *Hippocrates*. And on either ſide a *Membrane* is faſtend to the common mouth; ſuch an one as that which being daubed with a clammy Humor, doth compaſs the inner Cavity of the Larynx, and the outſide thereof is likewiſe covered thereby.

Veſſels | As for *Veſſels*.
The Larynx hath *Veins* from the internal Jugular.

It hath *Arteries* from the larger branch of the Carotides.

It hath *Nerves* which *Galen* terms *Vocales*, for the motion of the Muſcles, from the recurrent branch of the ſixt pair.

Kernels. | Two *parcels* of *Kernels* attend the ſame.
One *Parcel* at the upper part of the Larynx, viz. at the ſides of the *Uvula* or the Gargareon which are called *Tonſilla* or Amygdalæ, alſo *Pariſthima* and *Antiades* the Almonds of the Ears: which being Spongy (on each ſide one) do receive the moiſture of the Brain, turn it into Spittle and therewith moiſten the Throat, Larynx, Tongue and *Oeſophagus*; though it helps alſo our Taſting, which cannot be performed without moiſture. Theſe Kernels are about the Root of the Tongue, and are covered with the common Coat of the Mouth, and receive Veins from the Jugulars.

Spittle

They have placed by them two little white *Bladder-keys*, which receive ſerofity out of the Kernels, and void forth into the Mouth. *Riolanus* doth acknowledg no ſuch in a Man, but Suſtitutes in their ſtead Ligamental Membranes, ſtretched out from the *Uvula* to the Almonds.

Others ſtand by the lowerſide of the Larynx, on each ſide one, at the ſides of *Cricoides* and of the firſt ring of the Weſand, being great and ſpongy, through which Veins are ſpred, from the Jugularis externa. In Women it is more Perſpicuous; in a Man and in an Ox, more fleſhy and red.

The *Uſe* is, to bedew the Larynx, with a clammy and fat, but not fluid moiſture, that the Griſtles may be more fit for motion, and the voice may be made ſweeter: which is imitated by thoſe who anoint their pipes with Oyl.

The *Uſe of the Larynx* is to be the Organ of the Voice.

For the *Organs of the Voice* are either *Remote* or *Immediate*.

The *Remote* are the Cheſt and the Lungs, without the Aſſiſtance of the Heart; for if the four Veſſels of the Heart ſhould be tied, and the Heart cut off, yet a Dog can both run and bark, as beſides later Authors, *Galen* did often experiment: and the illuſtrious Sr. *Francis Bacon*, in his Hiſtory of Life and Death, *Article* 15. tels of an unbowelled Man, who after his Heart was taken out, uttered three or four words of his Prayers.

The *Immediate* are either preparatory, as the *Trachea*; or aſſiſtant as the *Muſcles* and *Nerves*; or conſervatory, as the *Mouth* and *Throat*. But the moſt principal part is the *Larynx*: and that part thereof termed *Glottis* is the next and adequate Organ of the Voice.

How the Voice is made?

Now the Voice is made after this manner: the Air is ſuddenly and ſtrongly blown out by the Lungs, and the Chink is moderately ſtraitned, where by the ſmiting of the Air the Voice is made, as we perceive the wind to whiſtle through the Chink of a Dore. And therefore *Ariſtotle* cals the Voice a ſmiting of the Air; underſtanding, in a cauſal way of expreſſion, the Action for the quality ſpringing therefrom. And if the breath go out, the Organ being wide open, it cauſes a *Sigh*.

Sighing.

And therefore, that noiſe which Animals make cannot properly be termed a voice, they wanting this Organ; as the noiſe which ſome fiſhes make, the croaking of Frogs, and the creeking of Graſs-hoppers. *Ariſtotle* tels us that the croaking of a Frog is made, when the Lip of the lower Jaw being equally let down, and a little water being in their Throats the upper Jaw which remains immoveable, is ſo forcibly bent, that their Eyes ſeem to ſparkle. But, it is evident, that a Frog hath Lungs, and a Chink in ſtead of a Larynx. And therefore the Voice is an Animal ſound, made by the Glottis through ſmiting the Air as it is breathed in and out, being produced to ſignifie the Conceptions of the Mind. And therefore Voice is only in living Creatures, nor is every ſound in them a Voice, but that which is made in the Glottis; not Coughing, nor hawking. If any Fiſhes make a noiſe, it is by their Gills or ſome ſuch thing, but not by their Mouths. Creatures without Blood and Inſects, as Bees, Waſpes, Locuſts and the like, utter no Voice, but as *Ariſtotle* rightly obſerves in his fourth Book *de Hiſtoria Animalium*, they make a noiſe which proceeds from their Back, as for example ſake, a Graſs-hopper makes a noiſe, by rubbing its wings one againſt another; For in theſe inſects there is contained a certain Spirit and Air, in a Membrane beneath the Septum Tranſverſum. Others will have it that inſects make ſuch noiſes by beating the Air after ſundry manners with their wings.

What is properly a Voice?

The differences of Voices, or Speeches.

The *Differences of Voices* are infinite, which are made, 1. By the Figuration of the Mouth. 2. By the different Percuſſion and Modulation of the Air, as we ſee in Pipes. 3. From the largeneſs and other qualities of the Inſtruments, viz. the Larynx, Weſand, Lungs and Cheſt. 4. According as the Voice comes to the Ear, intire or mangled. And beſides theſe differences, every particular Beaſt hath a voice of its own, which the Brutes themſelves can accurately diſtinguiſh, having herein a better hearing then Men. For a Lamb newly brought forth, knows its Mothers bleating among a thouſand Sheep, and the Ew likewiſe knows the bleating of her own Lamb from all others. Which is alſo true of Henns and Chickens. For the ſame voice never happens, becauſe the Inſtruments do never agree in all things: even as

Bells

Bells made of the same matter, the same weight, the same form, and by the same workman, do nevertheless alwayes differ in sound.

Parts of Voice or Speech. The *Parts of the Voice or Speech*, are Vowels and Consonants. We represent the Vowels only by five Letters, because the root of the Tongue is only moved by so many motions. But when a Vowel is further cut and modified, in the fore part of the Tongue, by the Lips and Teeth, it becomes a consonant, which therefore cannot be uttered without a Vowel, because that is its matter, seeing it arises only from a Vowel modified and cut: just as from the confused sound of a Pipe, an Articulate and Harmonious sound is made, when after a certain Method, the sounding Air is again stopped and cut by the Fingers.

Chap. XII. *Of the* OESOPHAGUS *or Gullet.*

THE OESOPHAGUS which some term *Gula*, others *stomachus*, and *Cœlius Aurelianus Via stomachi and Ventris* the way of the Stomach and Belly, in English the *Gullet*, is the Pipe or Funnel of the Stomach, as the Weasand is the Pipe of the Lungs.

Its Scituation. 'Tis so *Scituate*, as that it begins in the Throat, where it is termed *Pharynx*, and from thence goes down right forward, under the Weasand, into the Stomach. And when it is come as far as to the fift Vertebra of the Chest, giving way to the Aorta, which passes through the middle thereof, it bends to the right Hand; afterwards it rises again to the left great Artery, and at the eleventh Vertebra, through the Diaphragma or Midriff it enters the left mouth of the Stomach, accompanied by two Nerves arising from the sixt pair.

Its Vessels. It hath a few *Veins* from the Cava, the Azygos, Intercostal and Jugular Veins.

It hath *Arteries* from the Intercostal Arteries, and the internal Carotides.

And *Nerves* from the sixth pair.

Connexion. Its *Connexion* is, at the beginning with the Jawes and Larynx, by the Coat of the Mouth, which is common to it and the Stomach. To the Vertebræ, the Trachea and neighbouring parts 'tis joyned by Membranes arising out of the Ligaments of the Back.

When the Gullet is diseased, Medicaments are applied to the Back. And because it lies upon the Spina or Back-bone, therefore when it is Diseased, we apply external remedies to the Back-bone.

Its Kernels. A *Glandulous Body* grows to the hinder part of it, which affords moisture, to wet the Cavity thereof, the better to assist the swallowing of things. And sometimes it swels so much, as to hinder the swallowing of all liquid meats and drink.

Substance. Its *Substance* consists of a triple Coat, that it might more easily be stretched long-wayes and broad-wayes.

The *first* is common with the Stomach. This some will have to arise from the Ligaments of the Vertebra's, others from the Pleura, who are therein both mistaken. For it hath its rise, there where the Membrane of the Stomach arises, viz. from the Peritonæum, for it is one continued Body with the Membrane of the Stomach, it is exceeding thin and in a manner destitute of all Fibres.

The *second* is the first *Proper* one, the external being more fleshy, thicker and softer, then the other; being as it were a Muscle bored through, being commonly reputed to be interwoven with round and transverse Fibres. Also *Hofman* doth thereby prove it to be a Muscle, because it suffers Convulsions and Palsies.

The *third* is the second *Proper* one, internal, more Nervous, somwhat subtile and harder, being commonly said to be interwoven with streight and long Fibres. It is contained with that Membrane which covers the Palate, Throat and Lips, and therefore when a Man is ready to vomit, his lower Lip trembles.

Howbeit, contrary to the vulgar opinion aforesaid, our Eyes can witness, that the inner Coat is furnished with transverse and circular Fibres, the external with straight and longish ones.

Muscles. The *Muscles* of the Gullet which other have passed over in silence, are *four*.

The *first*, is the same I spoke of before, treating *de Larynge*. It is only one like a Sphincter Muscle compassing the Gullet. And therefore *Riolanus*, *Spigelius*, and *Vesslingus* term it *Musculus Oesophagus*, being the Authors of that name.

The second, is the *Sphænopharyngæus* by them so called, arising from the internal acute process of the Sphænoides, and being obliquely implanted into the sides of the Oesophagus, that it being drawn upwards and widened, it may be the more wide to receive in meat.

The third is *Stylopharyngæus*, which arising from the Bodkin-shap'd acute pr ocess, is stretched out to the sides of Oesophagus; which both Dilates and Amplifies.

The fourth, is *Cephalo-pharyngæus*, commonly said to arise from the Chin, but according to late Authors, from the lowest part of the Heads-top where it is nearest the Neck; and is inserted with a various contexture of Fibres into the beginning of the Oesophagus, where it is larger: and therefore because of its Latitud: and Fabrick, it seems to be two.

Whether Swallowing be a Natural or Animal Action? The *Action* therefore of the Oesophagus is Animal; seeing it is performed by Muscles and not natural, as the vulgar opinion is of all Authors, and swallowing doth doubtless depend upon our free will and liberty.

Now swallowing is performed after this manner: when any thing is to be swallowed, that same first Muscle which *Galen* terms *Sphincter* doth every way contract it self, whereupon its oblique Fibres, which reach from the Oesophagus to the Larynx, are made transverse, which being done, the Larynx is lifted up, and the Gullet is depressed; and the Cavity of the Gullet so depressed, is made more narrow. Hereunto the fourth Muscle is assistant. For as the first being contracted, embraces the meat which by chewing is brought into a round Mass, and so bears it down: so this fourth Muscle also contracting it self, comes out as it were to help, and that the meats received in at the Mouth may not go back, it straitens and repels them on every side, and transmits them into the Gullet, so that by both these Muscles contracted, and the Semicircular joyned therewith a perfect circle as it were and Sphincter is made, viz. by the fourth in the upper part of the Pharynx, and by the first in the lower.

The *Use* of the *Gullet* is, that by it as by a Funnel, meat and drink may be passed into the Stomach. And liquid things are indeed more easily swallowed then solid; contrarywise in some sick persons solid meats are more readily swallowed then liquid, because the faculty is more provoked by a stronger object, being otherwise lulled a sleep as it were; especially in the Palsie.

Why sometimes solid meats are more easily swallowed then liquid.

Chap. XIII. *Of the Neck.*

The Neck.

AN Appendix or Appurtenance to the middle Belly. is the NECK, as a medium between the Head and the Chest.

Why call'd Collum.

'Tis termed *Collum* a *Colendo*, because it is wont to be adorned: or a *Colle* from an Hillock, for it arises out of the Body, as an Hill out of the rest of the Earth.

Its Magnitude.

'Tis oblong for the modulation of the Voice; and therefore Animals which utter no true Voice, as Fishes and Frogs, have no Necks: and those which make the greatest Voice, have the longest Necks, as Cranes and Geese, &c. By the use of Venery the *thickness* of the Neck is altered, because heat distends the Aspera Arteria, the Carotides, and the Jugular Veins. Whence it was an ordinary Practice among the Romans to measure the Brides Neck the day after the Wedding, by which they knew whether she were a Virgin or Corrupted, as we learn out of *Catullus* and *Mercurialis*.

Its Parts.

The hinder part of the Neck is properly termed *Cervix*. Now the parts of the Neck are either external, as the Skin, Muscles, &c. or internal, as the Vessels which run through the *Trachea* and *Oesophagus*: of the latter I have spoken, of the rest I shall speak in their proper places.

Its Use.

The *Use* of the Neck is, 1. For the Oesophagus, Wesand, and Lungs. Hence Creatures that have no Lungs, as Fishes, have no Necks. 2. To be instead of an Hand to some Creatures, to take their meat with, according to *Galen*. 3. That it may afford Nerves to the fore-parts, the Shoulder, Cubit, Hand, Midriff; for those creatures only have these parts who have Necks.

THE

THE THIRD BOOK OF THE Uppermoſt Cavity, *VIZ.* THE HEAD.

Why the Head is placed ſo high.

THe third or *upper Venter* or Cavity is the *Head*, the chief manſion-houſe of the ſenſitive Soul which is placed in the top of the Body, for the Eyes ſake, which are there placed as in a Watch-tower; and requiſite it was that the Brain ſhould be near the Eyes, becauſe they have ſoft Nerves, which cannot be caried far.

Its Figure. The Head is *round* like a Globe, but a little flatned withal, and longiſh.

Greatneſs. 'Tis *greater* in Man then other Creatures, becauſe of the Largeneſs of his Brain.

Subſtance. And for more ſafeguard, the Head is altogether *bony*.

Diviſion. The Head is divided into the *Hairy* part, and *that which is without Hair*.

The former is termed *Calva*, the latter *Facies*.

Calva. The *external parts of the Calva* are theſe following.

Sinciput, which is the forepart reaching from the Forehead to the coronal Suture.

Occiput, which is the hinder part, reaching from the Lambda-faſhion'd Suture, to the firſt Vertebra of the Neck.

Vertex, which is the part ſcituate between the two former, bunching out.

Tempora, the Temples, which are the Side-parts, between the Eyes and the Ears.

Now the parts which *conſtitute* the Calva, are *ſome* of them *external* and *cloathing*, others internal and *contained*. The former are either common, as the Scarf-skin, the Hairy-skin, the Fat, the fleſhy Membrane: or proper as the Pericardium, Perioſtium, the Muſcles, the Bones, the Menings. The *contained* are the Brain, the Petty-brain, and the Marrow, which is partly in the Skull, partly in the Back-bone.

The Face. The *ſmooth part* of the Head, called the *Face* beſides the parts containing, hath parts proper to it ſelf, viz. the upper part which is called the *Forehead*, and the lower in which are the Organs of the Senſes; as the *Eyes*, *Noſtrils*, *Ears*, and *Mouth*, wherein the *Tongue* and other parts are concealed.

Chap. I. *Of the Hairs.*

IN the Head there is the greateſt plenty of Hair; therefore the Nature of the Hair may conuenientley be delivered in this place: though conſidered as an Excrement, it does not belong to this place.

What creatures have Hair. Hairs are found well-near in all Creatures that engender their young ones within their bodies, as *Ariſtotle* aſſures us: inſtead whereof Fiſhes have ſcales, Birds feathers, and ſome Beaſts as the Hedg-hog, have long ſharp prickles.

Now the *Hairs* are indeed Bodies, but not parts of the body, unleſs in a very large ſignification, as when we ſay ſome parts ſerve only to adorn the body.

The *immediate material Cauſe* of which the hairs are made, is certain fuliginous and excrementitious Vapors, thick and earthy, yet ſomwhat glewiſh and clammy.

Whether Hair & Nails grow of good nutriment. Its therefore falſe, which ſome affirm, that the Hairs and Nails are nouriſhed and generated of good and laudable nutriment. For they grow even in perſons conſumed and pined away, and being cut, they grow again in all ages of a mans life; and the oftner they are cut, the ſooner they grow again. Yea in dead men, as on thieves upon the Gibbet, &c. they grow. See *Paræus* at the end of his Book, who had an embalmed body in his houſe twenty four years together, the Hairs and Nails whereof grew again as often as they cut them. They are therefore bred of ſooty Steams and Vapors, of the third Concoction, or of the fleſhy ſubſtance it ſelf, by whatſoever heat reſolved into vapors.

The remote matter of Hair. The remote Matter, is nothing ſeminal out of which the hair ſprouts as a flower, nor any fat ſubſtance enclining

clining to the Nature of the Seed or Blood, but a superfluous moisture; especially that which is contained in the Kernels. And therefore where there are Kernels, in those places there are commonly Hairs, as at the Ears, in the Arm-pits, in the Groins, &c. And if sometimes there are Kernels without Hairs, this want of hair springs from a too great quantity of humors.

Where Hair breeds.

For the *Matter in which*, or the *Place* where hairs are bred, ought not to be too moist, nor too dry; as we see nothing grow in a wet fuliginous Soyle, nor in ground over dry and parched.

Why crusted Animals have no hairs.

And therefore the *Skin*, because it is a temperate part, as the place of Generation of hairs; but if it be too moist, or too dry, as in some persons it is, the hair does not shoot forth: and therefore crusted Animals, as Crabs, Lobsters, Oysters, &c. have no hairs.

The *Skin* therefore on which hairs must be bred, ought to be moderately dry, least the hair should fall from its root; but it must not be immoderately, but laxe and rare, least otherwise the hair should not make its way through. And therefore hairs may grow all over the skin, because it is every where porous, and every Pore hath the root of an hair fastned therein, excepting the palmes of the hands and the soles of the feet, which parts because of their continual motion and wearing, have no hairs, and because they were to be of an exquisite sense. And for this cause there grows no hair upon a Scar, because it hath no Pores.

Hairs also do sometimes grow on the inner Membranes of the Body, in the Heart as was said before, in the Womb, in the Urinary passages, Witness *Hypocrates, Galen, Schenkius*. Hair was found in the stomach by *Heer*, and lately in *Norway* hairs were voided by vomit from the Stomach, whether bred there, or taken in. At the Danish *Hellespont* red hairs were lately taken out of the musculous flesh of an Ox leg.

The *Efficient* Cause of hair, is not the Soul, nor any vegetative hair-making faculty, but moderate heat, drying up those fuliginous vapors, and thrusting them forth into the pores of the Skin.

Requisites to the Generation of hair.

These three things already explained, are the chief *Requisites* for the Generation of Hair, viz. The *Matter*, the *Place* convenient, and *Heat*.

Cause of baldness.

From whence by the Rule of Contraries, the Cause of Baldness may be gathered, viz.

1. When Matter is wanting.

2. When the Skin is Originally too dry, and afterwards grows drier, and is not moistened by any neighbouring part. Now the fore-part of the Head is here to be understood, which is commonly the only bald place; for no man, according to *Aristotle*, becomes bald on the hinder-part of his Head. For either Fat or other moisture in the hinder-part and the Temples keep them from baldness; fat in the fore-part, the Skin becomes dry and hard like a shell, and therefore is bald.

3. By reason of too much or too little heat. For weak heat does not sufficiently dry the matter, as in cold and moist persons, and such as are in years. And therefore the humor growing over hot by carnal Copulation, is the cause of baldness, and for this cause Boys and Eunuchs do not become bald.

4. Also four Husbandmen near *Bruxells* became bald by poyson, as *Franciscus de Paz* the King of *Spains* Physitian observed, and wrote thereof to *Nicholas Fontanus*; And *Hamelmannus* in his Annals tells of an Horse of the Count of *Oldenburg*, which by poyson was made bald hither, because this poyson had some specifical contrariety to the Hairs, or because the Spirits being extinguished, and the vigor of the Body quelled, the roots of the hairs could not be retained in the Skin. Such a poyson is the fat of a certain Whale in the Island of *Feroe*, newly taken out, by which Copper-vessels are also broken.

The Hairs are commonly *divided* into such as are bred in the womb, and such as grow afterwards.

Hairs bred in the womb.

Those bred in the Womb are threefold, those of the Head, of the Eye-lids, and the Eye-brows.

The Hairs which grow afterwards, are such as spring up when a man comes to a just age; that is, in a boy when he begins to breed Sperm, and in a Maid when her Courses break forth, for then the Skin grows open.

Also these are threefold: for 1. Hairs breed on the Share, seldom in the Womb and the Heart. 2. In the Arm-pits, also in the Nostrils and Ears. 3. On the Chins of men, but not of women; for in women their Courses spend the matter of hair which should make a beard, and therefore sometimes, when their Courses are poxt, women have hairs growing on their Chins. It was a rare case for a young woman of thirty years of age, one of the Arch-dutches of *Austria's* Women, to have ever since she was a Girl, before her courses brake forth, a long beard with mustachios like a man. And I saw such a like Girl not long since in the Low-countries, who was also hairy all her Body over. Lately *Helena Marswin* in *Fionia*, had a Girl with a long beard of a reddish yellow colour.

Use of Hair.

The *End* or *Use* of Hairs,

I. Is to cover the Parts.

II. To adorn them. And this is chiefly seen in the Hairs of the Head and Face. For

Why a man hath plenty of hair?

1. The Hairs of the Head do shield the Brain from external injuries of cold and heat, &c. So in *Æthiopia* by a peculiar thrumming of their hairs, they are defended from the heat. And as a man hath the greatest Brain of all Creatures, so hath he thereon most plenty of hairs.

2. They moderately heat, as otherwise in the Head there is no Fat to keep it warm: but rather a bony substance, and that far distant from the Heart. Now the hairs according to the advice of the Physitian, are to be let grow, or to be cut off in this or that person, but they must not be shaven off, because thereby Defluxions are caused. So also the beard does cherish and moderately warm the Chin. In persons that are recovering out of sickness, the hair must not be cut off, for fear of a relapse, touching which Question see *Sitonus*.

The Beard adorns.

3. They adorn: for bald persons and thin-hair'd are deformed. So the Beard also adorns a man, and makes him venetable, especially if the hairs be spred all about. But in women there was no need of so venerable an appearance.

III. To purge the Humors and Spirits, and the whole Body of superfluous sooty steams. And therefore frequent cutting the hair, quickens the sight, and *Celsus* in a long Defluxion of Rheum, bids us cut the hair to the skin. *C. Aurelianus* sayes that in the Phrenzie, when the hair is cut off, the parts transpire, being freed from a great burthen. Hence a reason may be drawn, why *Helmont* tasting an Asses milk, could tell whether

whether ſhe had been curried and combed that morning or not.

IV. To afford ſigns whereby to know the Temperament, Manners and hidden Diſeaſes of every perſon.

Their Form. The *Form* of Hairs is not the Soul, as many would have it, becauſe in perſons that conſume, and ſuch as are dead, the hairs grow; and thoſe who conceive with *Plempius*, that there is a Soul in perſons dead twenty four years, I leave the Readers to make an eſtimate of their Wiſdom. Nor do they retain a vegetative life in dead perſons, for ſo the whole man ſhould not die, nor is there any thing in a dead Carkaſs, that ſhould rather preſerve this life, then the ſenſitive or rational, not to ſay that theſe ignoble Parts by the long-laſting of their lives, ſhould excel all other parts. Plants indeed ſpring living from the lifeleſs Earth, but out of a living Seed, which I deny to be in the Hairs, and therefore they ſtick not in the Body like Plants, nor are bred thereout. Nor muſt we ſay with *Plotinus*, that certain reliques of life remain after death, as warmed rooms remain hot, when the fire is out; for ſuch Reliques of life could not remain ſo many years. The form therfore of the hairs may be deſcribed by their accidents, which are theſe following.

Magnitude. 1. *Magnitude*: Now the Head-hairs are longeſt, becauſe the Brain is greater then the reſt of the Kernels: alſo they are thickeſt, becauſe the Skin of the Head is moſt thick, howbeit it is laxe and open, and contains ſufficient moiſture.

According therefore as the Skin is thick or thin, rare or compact, and the humor plentiful or ſcanty, and the heat weak or ſtrong, the hairs become thick or thin, hard or ſoft, plentiful or ſcanty, &c. He had ſtore of hair on his Head, who could ſuffer himſelf to be ſhot in the head with a bullet, and had no hurt, whom *Busbequius* ſaw in his Voyage to *Conſtantinople*. Yet they grow not infinitely, becauſe the Exhalations are not ſo plentiful, nor does the expulſive Faculty work infinitely.

Figure. 2. Their *Figure*: The hairs are ſtraight and flat, in ſuch as abound with moiſture, but curled in ſuch as are dry. Therefore curled hair is harder then that which lies flat. Hence all Blackmores are curle-pated, becauſe of their dry Temperament. But the Scythians and Thracians have long flat hair, becauſe they are moiſt, according to *Ariſtotle*. Again the hairs are ſtraight becauſe of the ſtraightneſs of the paſſages through which they break forth; and criſp becauſe of the crookedneſs of the ſaid paſſages. The augmenting Glaſs informs us that the hairs are quadrangular; though others will have them to be round becauſe of the roundneſs of the Pores.

Alſo they are porous or hollow within, as the Diſeaſe *Plica* in *Poland* does ſhew, and the hairs of an Elk. Again becauſe they may be ſplit, they have Pores, according to *Ariſtotles* maxime.

The cauſe of the colour of the hair. III. Their *Colour*: which in Brutes follows the colour of the Skin; and in men is exceeding variable, according to the Country, ambient Air predominant Humor, Age, &c.

For thoſe that dwell in hot and dry Countries, have their hair not only dry, criſp and brittle, but alſo black, as the Ægypians, Arabians, Indians; alſo the Spaniards, Italians, and part of the French have their hair for the moſt part black. They who dwell in cold and moiſt Countries, have their hairs not only ſoft and ſtraight, but for the moſt part yellow or white, as the Inhabitants of *Denmark*, *England*, *Norway*, *Swedland*, *Scythia*, &c.

Again the predominant Humor makes the Colour of the hairs: as in flegmatick perſons, the hairs are for the moſt part white, and ſo of the reſt.

Alſo the Variety of Heat makes variety of Colours: for immoderate heat makes black hairs: for a vaporous Excrement is raiſed by the heat, and is changed into an exact ſooty ſtream. But temperate heat makes the hairs yellow; more temperate makes them red; a weak heat makes them white. But both theſe cauſes of Colours do eaſily concur in the hair, as when flegm abounds, weakneſs of heat is joyned therewith, and when Blood abounds, heat is moderate, &c.

Alſo a change in the Colour is made in reſpect of Age, as alſo of other accidents. For grown perſons have their hair not only thicker, harder, ſtronger and more plentiful, but at length alſo grey and whiteiſh.

But no Hairs on the Body of Man are Naturally green, or blew, though there are both green and leek-colour'd Choler in Mans Body; the cauſe whereof is not the thickneſs of the hair, uncapable of light, as *Cardan* imagined, becauſe the hair is capable of being yellow, its thickneſs nothing hindring; but, as *Scaliger* rightly philoſophizes, ſeeing every colour is not agreeable to every Plant, no more is it to the hairs. Yet I have ſeen green hair'd men at *Hafnia*, and thoſe as work Metals have their hair commonly green. *Marcellus Donatus* relates of *Antonius Maria Catabenus*, grey hair'd through Age, how that much Choler mixt with blood abounding in his Body, not only his Skin became of a Verdigreeſe or yellow-green colour, but his grey hairs were alſo died of the ſame hue.

The cauſe of grey hairs. The Ancients conceived that grey hairs did proceed from drineſs, as the Leaves of Trees when they are dried, look white.

But *Ariſtotle* confutes them. For thoſe who go with their heads covered, do ſooner grow grey, and yet are not ſo dried, as thoſe that expoſe their heads bare to the air. Again ſome are grey as ſoon as they are born or quickly after, which cannot proceed from Dryneſs.

Why they are ſooneſt grey-hair'd that go with their Heads cover'd? Now they grow ſooneſt grey that go alwaies with their Heads covered, becauſe the heat cannot be fanned, but is overwhelmed and ſtrangled, which being extinguiſhed, an external heat is introduced; ſo that putrefaction is the cauſe of grey hairs, which ſprung from ſcarſity of innate heat, which cannot ſo digeſt the humors as in youth. And the outmoſt and ſmalleſt end of the hair is whiteſt, where there is leaſt heat.

Why Men are ſooneſt grey about their temples? Now why a white Humor ſhould ariſe from putrefaction, the Cauſe is, according to *Ariſtotle*, becauſe a great part is turned into Air, which being well mixed with an earthy and watry Subſtance makes whiteneſs. Hence alſo it is apparent, why men are ſooneſt grey about their Temples, becauſe there great and fleſhy Muſcles are placed under the Skin, which through moiſture do eaſily putrifie. Add hereunto, that the Bones of the Temples are very thin, and therefore extraneous heat can eaſily paſs through them.

Chap. II *Of the Membranes without and within the Skull.*

THE EXTERNAL MEMBRANES which compass the Skull, are two: The PERICRANIUM and the PERIOSTIUM which compass the Brain; also there are two Meninges or *Matres* so called, viz. DURA MATER and PIA MATER, that is to say a thick Membrane and a thin one, which perform the same Office in their Cavity, which the Pleura performs in the middle Cavity and the Peritonæum in the lowest.

The Pericraneum. The PERICRANEUM is a Membrane thin and soft, compassing the Skull, and springing from the *dura Mater* coming out at the Sutures of the Skull.

That it springs from the *dura Mater*, the extraordinary Consent between the Brain with its Meninges and the Pericraneum, does sufficiently prove, which cannot be by any other way more conveniently made forth. Moreover, this production of the Pericranium from the *dura Mater*, is manifestly visible in Infants, in whom the Moles of their Heads are not yet sufficiently closed. Those Fibres wherewith *Horstius*, *Spigelius*, and *Laurenbergius* do conceive that the Pericraneum is only fastned to the *dura Mater*, do not go unto the Throat: for the Bones being by little and little hardned and compressed, that same Continuity of the Pericraneum and *dura Mater*, was broken off with Age, from whence arose that appearance of Fibres which hath deceived some.

Periostium. The PERIOSTIUM is a most thin and nervous Membrane, and therefore exceeding sensible, by help whereof, all the bones saving the teeth being compassed therewith, become sensible.

I distinguish these two Membranes with *Vesalius* and *Bauhinus* against *Fallopius*, *Laurentius* and others, who confound them, seeing they may be accurately separated by a skilful Anatomist.

Now the various Muscles about the Head shall be explained in their proper place.

Crassa Meninx. The CRASSA MENINX or harder Membrane called also DURA MATER, because of its thickness and hardness, and because many conceive all the Membranes of the Body do arise out of this and the *tenuis Membrana* or *pia Mater*, does cover the Skull all over on the inside, and all its Cavities and hollowness; and sticks strongly to its Basis, so that some have thought it took its Original from thence.

Now it compasses the Brain also loosely, on the upper side, and covers the inside of the Skull. (For whereas *Hildanus* and *Varolius* have observed that it is straitly fastned to the Skull, that was besides the ordinary Course of Nature) that there may be some distance between, as there is between the Heart and the Heart-bag, both in living and dead bodies, though in the latter it is greater, by reason of the defect of Spirits and the falling in of the Brain, which I grant *Olhafius* and *Hofmannus*; and this is so contrived that the swelling Vessels of the Brain, may not be compressed, and that there may be no hindrance of the

The Brain moves. *Motion of the Brain*, which is made up of Systole and Diastole, and is continual, as may be seen in Wounds of the Head, new born Children, and most vehement pains of the head, as *Fabricius Hildanus* hath observed: And I my self have frequently seen this motion in wounded persons. Strange therefore it is that some learned men will needs deny this motion. But it is a very hard task to assign the true Cause of this motion: Some make it to be the Meninges; others the Arteries; others the Substance of the Brain. But it is ill ascribed to the Meninges: for a great portion of the brain being taken away, and the Meninges themselves, the brain was observed to move in a living Sheep, by the *renowned Riolanus*. They judg better who ascribe the same to the Arteries, for the motions of the Brain and Arteries do happen both at one and the same time, as may easily be observed in Fractures of the Skul, and in the Heads of Infants. Yea and *Walæus* observes that in those who being wounded in the Head to the Brain, have extream anguish, only certain conspicuous Arteries do move, and not the Substance of the Brain; and when the parties wounded gather strength, the motion of their Brain evidently returns. Also *Coiter* hath observed in living Lambs, Kids and Dogs, that the brain it self hath no motion but only the Arteries. To him *Olhafius* gives consent, because the motion is most observable about the Cavities of the dura mater, where are most Arteries. And therefore I conceive we must not have recourse to the substance of the brain: which is also soft and flaggie, and sufficiently indisposed for motion. But the chiefest motion is observed at the full of the Moon, by reason of the working of the humors at that season. But that also springs from the Arteries, which are more distended with blood: for the motion of the Heart becomes quicker or slower, according to the various Influence of the Stars. That the motion of the brain should answer the motion of the Lungs, I have no sufficient sign to prove.

Now *it is fastned* to the pia mater and the brain, by Vessels; to the Skul by thin membranous fibres springing out of it self, passing out through the sutures, and constituting the Pericranium.

This Meninx or Coat is double, as the rest of the Membranes are. The external part respecting the Cranium, is hard, rough, and of a small sense, because of the hardness of the Skull which it was to touch.

The inner part is smooth, slippery, brightly shineing and white, being more drenched with a waterish moisture.

It is *fourfold* where it distinguishes the Brain from the petty-brain, in which place Dogs have a bone underpropping their brain, that it may not bear hard upon the Cerebellum, Branilet, or petty-brain.

But on the Crown of the Head it is doubled, where it divides the brain into the right and left part: and because the Reduplication is in the hinder-part broad, and grows afterwards narrow by degrees, yet not to a point, so as to represent a Reapers Sickle, therefore they term this Body *Falx* the Sickle. And while it is thus multiplied, it constitutes.

The Sickle. *See Tab.* II.

Cavities hollownesses, being receptacles of abounding blood and Spirits, and they are four in number; which *Galen* sometimes calls the *Ventricles* of dura Mater; and others call them *Sanguiductus*, Cisternes of Blood.

The upper Cavities.

The *first two* begin at the Basis of the Hind-part of the Head, by the sides of the Lambda-shap'd Suture, where the Veins and Arteries disburthen themselves. The Veins truly, of the jugular branch are manifestly inserted, and receive blood out of the Cavities; but the Arteries, whether mediately by certain branches of the Cavities,

The first two.

The FIGURES Explained.

This TABLE Represents the Coverings of the Brain both proper and common, in the same order in which they are represented in Anatomical Dessections.

FIG. I. Shews the enternal Parts.

AAA. *The Skin and the Scarf-skin with the Roots of the Hairs.*
B. *The true Skin separated from the Scarf-skin,* C.
DDD. *The Membrana Carnosa furnished with little Veins.*
EE. *The Muscle of the Fore-head out of its own proper place, receiving the Nerres which come out of the hole,* O.
FF. *Fat spred over the Skull.*
G. *The Pericranium lying upon the Periostium in its natural Situation.*
I. *The same separated from the Periostium and turned inside out.*
K. *The Periostium spred out upon the Skull.*
L. *The same pluckt of from the Skull.*
MM. *The Skull naked.*
N. *The Coronal suture.*
PP. *The Sagittal suture.*
QQ. *The temporal Muscle as yet covered with the Pericranium.*

FIG. II. The Skull being taken away this Figure discovers the Coats of the Brain.

AA. *The dura Mater covering the left side of the Brain.*
bbb. *Veins and Arteries sprinkled up and down the same.*
CCC. *The Brain covered only with the pia Mater.*
dd. *The turnings and windings of the Brain.*
eeee. *Vessels sprinkled up and down the pia Mater.*
F. *The dura Mater drawn downwards.*
GGG. *The upper Cavity engraven in the dura mater.*

The I. TABLE.

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Cavities, as *Walæus* suspects, or knit immediately to the Cavities themselves, do disburthen themselves, into the Cavities, And these two being afterward united, do make up.

The third. The *third* which is longest of all: For it goes all along the Head to the tops of the Nostrils. *Galen* sometimes calls it a *Vein*, because it contains store of Blood. And when these Cavities are opened, an immeasurable quantity of Blood comes out by the Nose, which is supplied from the Arteries.

The *fourth Cavity*, not reaching to the Skul as the former, is short, and goes inwardly between the Brain and the Brainelet, unto the Glandula pinealis.

It arises, where the three former meet together, and this beginning some from *Herophilus* call *Torcular* the Wine-preft; and *Nymmannus* conceives that this part is cheifly obstructed in the Apoplexy. But 1. We do somtimes allow thereof, as a remote Cause. for all that accident is to be referred to the noble Ventricle. 2. Vital blood may be brought to the Brain by the *rete Mirabile*, whence Vessels go for Nutriments sake, to the substance of the Brain.

The *third*, or the uppermost of the sickle, and the *fourth* Cavities, do seem to me to end into the two former, or greater lateral ones; in which I follow *Fr. Sylvius* exceedingly verst in the Anatomy of the Brain: and that not by a streight passage, but inclining to the sides; so that there is no common concourse of these four Ventricles; though these greater lateral ones are joyned by an intermediate passage or Channel. Yet here also I have found some diverfity according to the variety of subjects, so that they have somtimes met, and somtimes been separated. *Riolanus* makes the *Torcular* with *Galen* to be in the third longitudinal Cavity, because it distributes blood into all parts of

See *Tab. II.*

the

the Brain and Brainlet or Cerebellum, which Reason holds truer in reference to the Arteries.

The lower Cavities.

Besides those four Cavities or Ventricles already described, *three others*, by the Information of *Sylvius* have in dissection presented themselves to me; which nevertheless, I have not always, and I tell you so much, least any man not finding them presently in one or two Bodies, should accuse me of falshood. *Riolanus* accounts them to be Coherences of the Duplicated Brain, spred under the greater once. by the intercedency of the *pia Mater*. Which is nothing, for they have Cavities as the others have, nor are they naked Coherences.

See *Tab. II.*

The one of these, which was also observed by *Vesalius*, is carried through the lowest part of the Sickle, and therefore I have termed it, the lower Ventricle of the Sickle; and for distinctions sake, I have termed that which is commonly call'd the third, the upper Ventricle of the Sickle. This lower Ventricle of the Sickle, ends into the fourth Ventricle.

The *other two* smaller lateral ones, on each side one, are distant about a thumbs breadth from the greater, situate in the dura Mater which distinguisheth the Brain from the Brainlet, not being so long as they. The one of them goes into the great lateral Cavity; I have also seen them ending into the fourth.

From the Cavities arise the branches or creeping jugular Veins, and into them the *Arteriæ Carotides*, being distributed upwards and round about, and opening into them by mutual Anastomoses.

Now the blood is contained in these Cavities in very great plenty, because the bulk of the Brains substance is very great, and they perform the office not only of Veins but of Arteries also, seeing they Pulse as

The FIGURE Explained.

This Figure Represents the right side of the Brain, cut away to a great depth, according to the passage of the Ventricle.

The II. TABLE.

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A. *The Nose.*
B. *The right Ear.*
CCCC. *A portion of the Skin of the Head hanging down.*
D. *A Rudiment of the Muscle of the Hind-part of the Head.*
E. *The Socket of the Eye.*
F. *The Forehead Bone.*
G. *The Bone of the Hinder-Head or* Occiput.
HH. *The left side of the Brain, covered as yet with its dura Mater.*
III. *The dura Mater of the right side hanging down.*
KKK. *The Falx or Sickle.*
L. *The End of the Sickle at the Galli Crista or Cocks-Comb.*
MMM. *The upper Cavity of the Sickle.*
NN. *The lower Cavity of the Sickle.*
O. *The greater Right-hand lateral Cavity.*
P. *The ingress of the upper Cavity of the Sickle into the greater lateral Cavity.*
Q. *The fourth Ventricle between the Brain and the Brainlet.*
R. *The ingress of the fourth Ventricle into the greater Lateral one.*
S. *The common passage of the greater lateral cavities.*
TT. *A portion of those great Vessels which pass into the upper cavity of the Sickle.*
VV. *Part of the great cleft in the Brain.*
x. *The lower and outer part of the right Ventricle, where a little twig of the corotick Artery, peirces as far as the Plexus Choroides.*
y. *The hinder and larger part of the right Ventricle.*
z. *A roundish cavity of the right Ventricle resembling the finger of a Glove.*
a. *The upper and inner part of the right Ventricle, under the Corpus callosum.*
b. *The descent and orifice of the right Ventricle going into the third or middle-most.*
ccc. *The Glandulous intertexture called* Choroeides.
dd. *The Root of the spinal Marrow.*
e. *The Brain continued to the root of the spinal Marrow.*
ff. *The Corpus callosum so called.*
gggg. *The hinder and lower part of the Brain, continued to the Corpus callosum, and forming the cavity of the right Ventricle.*
hh. *A portion of the left side of the Brain appearing under the Falx or Sickle.*
ii *Little Arteries creeping along the Surface of the right Ventricle.*

the

the Arteries do. Which *Walæus* could never perceive in the diſſected brains of live Creatures, nor in fractures of the Skull. Though it be evedent even to thoſe that open the Skull with a Trepan, as *Riolanus* confeſſes.

The Uſe. The Uſe therefore of the Ventricles, is not ſo much to contain the two ſorts of Blood, received from the Veins and Arteries; as only to receive the Arterial blood, by means whereof they Pulſe. For the Arterial blood communicated to the Brain by the *Arteria Cervicalis*, which remains over and above after the Nutriment of the Brain and Brainlet, and the Generation of Animal ſpirits, is voided into theſe Caveties, either immediately or mediately, by the little twigs of the Cavities, as *Walæus* ſuſpects; and from thence through the jugular Veins which are joyned to the Ventricles, together with a thin Skin cleaving to their Walls, it runs back downwards to the Heart, that it may be wrought over again. For that the blood is circularly moved in the Brain alſo, appears likewiſe by the Ligatures of live Creatures; ſeeing the jugular being bound, ſwels towards the Head, but is empty and lank towards the Cava and Heart.

P. Laurenberg conceives the Animal Spirits are generated in the Cavities, without any firm judgment or probable Reaſon.

A. Kyperus a moſt learned Man, conceives that a ſpecial uſe of theſe Cavities is, to ventilate and cool the blood, for the better ſervice of the Brain and the Generation of Animal Spirits; ſeeing the extremities of the Arteries do end in them, and the Ventricles themſelves are cloſed in by a ſingle, cold Membrane. But in my Judgment the Arterial blood does not come into the Cavities, before it be cooled, when it returns from the Generation of Spirits. And then it needs no cooling, being to return immediately through the Veins into the Heart.

The *Uſe of the dura Mater* is, I. To cover the brain with the Marrow and Nerves thence ariſing.

II. To diſtinguiſh the Brain from the Brainlet, and the Brain it ſelf into two parts.

III. To conſtitute the *Pericranium*, while it ſends Ligaments therefore, through the Sutures.

Pia Mater. The *pia Mater* call'd ſo becauſe of its thinneſs, doth immediately encloſe the Brain, and its Parts and Ventricles, leaſt they ſhould run about; therefore it was to be thin and ſoft; and it is of moſt exquiſite ſenſe. It is thicker in the third Ventricle, then the reſt, if we will believe *Olhofius*. The ſenſe of this Membrane was more dul in him that had three bones growing thereto without hurt, which were ſeen at *Paris* by my Coſin-German *Henricus Fuiren*: & in that Venetian, who had a pretty large toothed Bone, growing in *Falce* or the Duplicature of the *Meninx*, which *Folius* did ſhew me.

Its *Uſe* is; To cloath the Brain, the Brainlet, the Marrow and the Nerves.

Chap. III. *Of the Brain and its Marrow in General.*

WIthin the Skul a threefold ſoft and white ſubſtance is to be conſidered: the Brain or foremore Part, the Brainlet or *Cerebellum* the hindmoſt part, and the inmoſt part which lies deep under the Brain being a white Marrow; which becauſe others do ignorantly confound with the Brain it ſelf; I do thus truly ſet down the truth of the matter.

The *Brain* commonly ſo called hath two parts, the one *Internal* the other *External*.

What is properly the Brain. The *External* part is properly and ſtrictly called the Brain and is all that which appears outwardly ſoft, of an Aſh color or yellowiſh white; which color ſome conceive to ariſe from an innumerable company of Veins there diſſeminated; and this External ſubſtance is as it were the bark.

The Marrow what? The *Internal* is the remaining ſubſtance which lies hidden beneath the the former, being more hard compact and white, which we may call the Marrow, in which are ſeated the Ventricles commonly ſo called, but not in the Brain it ſelf; ſo that

How they differ? The Brain and Marrow it ſelf *Differ*, 1. In Situation. 2. In Color. 3. In Conſiſtency. 4. By the going between of Lines. 5. In Magnitude. 6. In Figure. 7. In Cavities, which are in the Marrow, not in the Brain. 8. In Nobility.

The white part therefore of the Brain ſeems to be buryed in the Aſh-color'd part, as the Chryſtalline Humor is in the Glaſſie. And though theſe two ſubſtances, the White and the Aſh-color'd, do in dead Carcaſſes putrified ſeem very cloſely united and continued one to another; yet in the freſh bodies of healthy perſons ſuddenly killed, they are ſeparated with ſundry lines, ſo that they may be very well actually ſevered, if great Dexterity be uſed, and Diſſection be begun preſently after the parties death, otherwiſe they are overflowed with much moiſture and fall in.

Parts of the Marrow. This middlemoſt white ſubſtance or *Marrow, I divide into the round* and *long Parts*.

The Head of the Marrow, what? The *Globous* or *round part*, which I ſhall call the Head of the Marrow, reſembles the Figure of the Skul, and is of great bulk, having in it three Cavities or Ventricles commonly ſo called.

A new opinion concerning the place where the Animal ſpirits are made. The *long* part, which I will call the Tail of the Marrow, ariſes immediately out of the former like a certain Tail, wherein is ingraven the *Calamus Scriptorius* or fourth Ventricle ſo called by ſome; wherein I hold the true Generation of Animal Spirits to be affected.

And this long Portion of the Marrow, is the beginning and original of all Nerves whatſoever that are in that place; contrary to what is commonly thought.

Alſo this lengthened *Marrow* may be conſidered in a twofold manner: either as it remains ſtill *within the Skul*, and then the Nerves ariſe therefrom, which are vulgarly attributed to the Brain: or as it is without the Skull, and ſlides into the Back-bone, gaining the title of the Spinal Marrow.

But that young Learners may not be confounded, I ſhall now propound the ſtructure of the whole Brain commonly ſo called.

The Magnitude of the Brain. The *greatneſs* of a Mans Brain is remarkable in proportion to the reſt of his body, as *Ariſtotle* obſerves. And for the moſt part a man hath twice as much

Brain as an Ox, viz. the quantity of four or five pound weight, becauſe he is a more noble Creature, and perpaps becauſe he goes bolt upright: for when when we would have any thing that is moveable to ſtand upright we put a great weight on the top, to prevent its falling. Yet the ſcull of a monſtrous beaſt lately found in *Scania*, might preternaturally contain twice that quantity of Brain. The Skull it ſelf is kept in the ſtudy of *Wormius*.

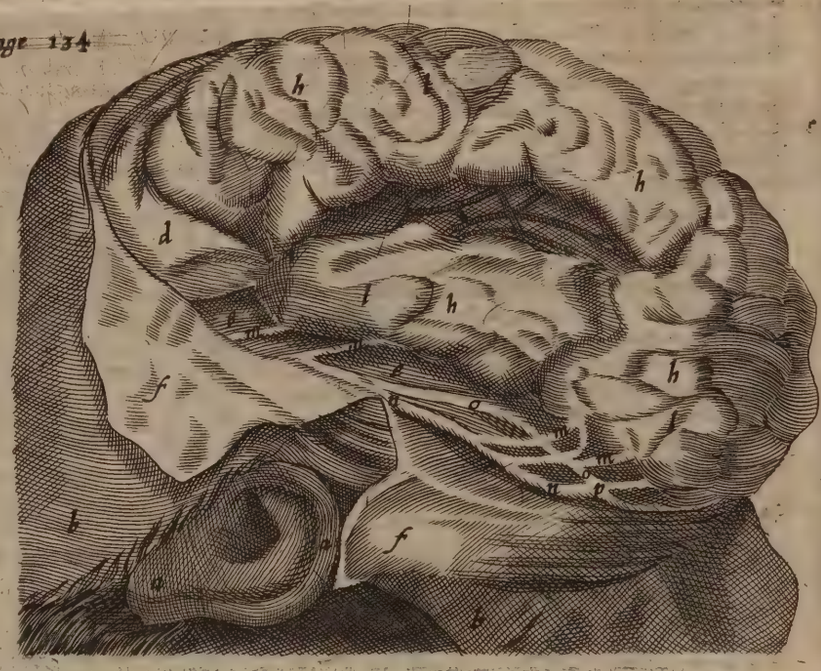
Who have moſt Brains.

And among Man-kind, Men have more Brains then women. For to them the greateſt brain is given, that have moſt need of brains, and greateſt uſe of them, for the exerciſe of ſundry excellent Animal faculties. Yet *Spigelius* or *Bucretius* will not allow of this difference of the brains of the two Sexes, moved doubtleſs by Ocular Inſpection, and the great Minds and Endowments of ſome Women, which the foregoing Age and this of ours have brought forth. But Women are therefore ſaid to have leſs brains then men, becauſe for the moſt part they have leſs bodies.

It is of a roundiſh ſhape anſwerable to the Skul; yet inwardly the brain hath certain knobs, which by ſome are cal- *Proceſſus mammillares*

Knobs of the Brain.

The III. TABLE.



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The Explication of the FIGURE

This FIGURE preſents the left ſide of the Brain bowed back into the place of the right, which according to the foregoing Figure is taken away, as alſo the great Clift of the ſaid Side.

aa. *The left Ear.*
bb. *The Skin of the Head hanging down.*
cc. *Part of the Fore-head-Bone.*
d. *The Socket of the Eye.*
eee. *The Hollowneſs of the Skull, wherein the lower part of the Brain was contained.*
ff. *The dura Mater hanging down.*
hhhhh. *The left ſide of the Brain inveſted with the pia mater*
iii. *The great Clift of the left ſide of the Brain, ſeated over the Root of the Spinal Marrow.*
kk. *The left Root of the Spinal Marrow, appearing in the Bottom of the great Clift, with new Rudiments of the winding, and Veſſels there diſtributed.*
llll. *The windings of the Brain, according to which the Branches of the Carotick Artery are diſtributed.*
mmmm. *The Branches of the Carotick Artery, ending into the larger left-ſide Ventricle.*
nn. *The greater left-ſide lateral Cavity or Ventricle.*
oo. *The ſmaller left-hand lateral Ventricle.*
p. *The Entrance of the ſmaller lateral Ventricle into the greater*

Why the Brain hath windings.

The outward ſurface of the brain is ful of turnings and windings like thoſe of the Guts: which we muſt not ſay were made for underſtanding with *Eraſiſtratus*, ſeeing Aſſes alſo have them; nor for lightneſs ſake as *Ariſtotle* would have it; nor that they are without End or Uſe, as others conceit; but that the Veſſels of the brain might be more ſafely conveighed through thoſe turnings and windings, leaſt they might by continual motion be in danger of breaking, eſpecially at the ful of the Moon, when the brain doth moſt of all ſwel within the Skul.

The winding Clift of the Brain.

The windings of the brain (which I firſt learnt of *Fr. Sylvius* a great Anatomiſt) if you diligently examin the matter, you ſhall find to deſcend a good depth, & that the brain doth gape on each ſide, over & above that ſame middle diviſion made by the Sickle, with a winding clift, which begins in the forepart, about the roots of the Eyes, whence according to the bones of the Temples, it goes back above the Root of the ſpinal Marrow, and divides the upper part of the brain from the lower part. Yet now and then, that ſame great Chink cannot be found or very hardly. In ſtead thereof I have found a certain ſmal lateral clift on each ſide eaſily ſeparable, even in the common ſection, near the Ventricles, ful of the Carotick Arteries.

See *Tab* 3.

The *inner* Surface hath ſundry Extuberances and Cavities, as ſhall be ſaid in the following diſcourſe.

The

The Colour The *Colour* is white, because the brain, as all other parts hath its original from the Seed, but so, that it hath less of Amplification then of Constitution: and therefore in extream fastings the brain suffers no diminution.

Its temperament. Its *Temperament* is cold and moist, which appears from its whiteness and moistness. And therefore *Hippocrates* saies the brain is the seat of cold and clammy humors. For the overgreat heat of the brain is an hinderance both to Reason and Sleep, as appears in Phrenetick persons. Yet is it by reason of the spirits hotter then any Air, as *Galen* rightly saies; yet is it not so exceeding hot. as the Heart

Why the substance of the brain is moderately soft? Its substance is proper to it self, such as is not in the whole body besides. *Hippocrates* doth liken it to a Kernel, by reason of the Colour and plenty of moisture. It is soft and moist for the more easie impression of Images and Conceptions, for it is the seat of Imagination: Yet is it not so soft as to run about, but hath a consistent softness, so that what is imprinted therein, may continue for a season: for the brain is also the seat of Memory.

The followers of *Des-cartes* doth weave the brain together of soft and pliable Fiberkies, mutually touching one another, with intermediate spaces of the pores, by which Fiberkies the Images of Objects are imprinted upon the brain. They do indeed excellently explain the reason of Sense, if this *Hypothesis* of theirs were true. But such Fiberkies are not found in the soft substance of the brain, unless we shall mean the beginning of the Spinal Marrow, out of which the little Ropes of Nerves do arise.

It is a rare case for the substance of the brain to be quite wanting, but *Horstius* saw it somtimes much diminished by over great use of carnal Embracements, as his Epistles shew. Howbeit *Schenckius, Valleriola, Carpus, &c.* saw a Boy without any brain; as also *Nicolas Fontanus* at *Amsterdam* in the year 1629, who in stead of a brain and spinal marrow, found a very clear water enclosed in a Membrane.

There are Veins in the Brain. Sundry Vessels are Disseminated through the brain. For if you squeeze the substance thereof, many little Dripplekies of blood do sweat out: and therefore I conclude with *Galen* that very many capillary Veins and Arteries are there disseminated: which I have also divers times beheld with mine Eyes. Which will then principally happen, as *Fr. Silvius* observes, when the brain is Flaccid and Friable, because he observed that then it would come of it self from the Vessels, in dissection; and especially if the Vessels by means of Age, or any other waies, are become more solid then ordinary.

Now there are no *Nerves* Disseminated through the Brain and therefore it is Void of all Sense.

The Veins which are carryed through the substance of the brain are, 1. The five branches of the jugular Veins, some of which go into the Cavity of the dura mater, others are spred up and down through the Coats and substance of the brain. But they, according to the Observation of *Walæus*, are no other then, 2. very smal twigs, which on either side go into the substance of the brain, out of the Cavities of dura mater.

There are four Arteries from the Carotides and Cervicales, whereof the former are disseminated into the brain upwards and downwards, the latter into the Brainlet or Cerebellum. In the Chinks the same Carotick Arteries are carried in very great number, both in the surface and the bottom, which *Fr. Sylvius* conceives to be the cause of that same troublesome pulsing about the Temples in some kinds of Head-ach: though in the judgment of *A. Kyperus* the pulsation of the external Arteries adds somwhat hereunto, as the Cure of the pain doth shew, by opening the said Arteries.

The Use of the Brain. The *Use of the Brain* according to *Aristotle*, is to cool the Heart, which *Galen* justly refutes, because the brain is far from the Heart. But there are some Peripatetick's who deny that *Aristotle* dissents from the Physitians, while he saith the brain is made to temper the heat of the Heart, and they will have it made to produce Animal spirits: In as much as the Animal spirits cannot be generated, unless the vital Spirits be first cooled But,

The *Use* thereof is, 1. To be the Mansion of the sensitive Soul, for the performance of Animal Functions. Now the brain is no particular Organ of Sense, as the Eyes, Ears, &c. but an universal one: for judgment is made in the brain of the Objects of all the Senses.

Of the brains Motion. Also it passes judgment touching Animal Motion, whereas it self hath no Animal Motion: But it hath a Natural Motion, communicated from the Arteries, and that a perpetual one of widening and contracting it self, as appears in Wounds of the Head and new-born Children, in the forepart of whose Head, the brain is seen to pant, because their bones are as yet exceeding soft and plyable.

In its Dilatation the brain draws vital Spirit with arterial blood out of the Carotick Arteries, and Air by the Nostrils.

In its contraction it forces the Animal spirits into the Nerves, which like Conduit pipes carry the said Spirit into the whole body, and therewith the faculties of Sense and Motion. And by the same Contraction, the blood is forced out of the Ventricles through the Veins unto the Heart.

The Matter of the Animal Spirits. The Matter therefore of the Animal Spirits is two fold; viz. Arterial blood ful of vital Spirit, and Air. Touching the place of its Generation we shall speak hereafter. For I am not of their opinion who confirme that this Spirit is Generated in the substance of the Brain, or in those Ventricles in the forepart thereof.

2. That the Animal spirit may be contained and kept in the brain as in a Store-house, after it is generated. And the substance, truly, of the Brain is a convenient House and Receptacle for the Animal spirit, seeing it is the same with the internal Marrowy substance of the Nerves, which also contains the said Animal Spirit.

A new opinion of the Author, touching the use of the Brain and the Marrow. Now I am of Opinion that in the Brain, properly so called, or the Rinde, is contained Animal Spirit for Sense; and that in the whole Marrow Head and Tail, Spirits is kept for Motion, which shall be made manifest in the following Chapter.

Chap. IV.

Of the Parts of the Brain in Particular, and I. of the lengthened and Spinal Marrow, and its noble Ventricle.

The right Dissection of the Head must begin at the lower Part.

SOme with *Galen, Vesalius, Fallopius,* intending to contemplate what is contained in the Brain, begin their Dissection in the upper part and proceed to the lower, and therefore they do unfitly propound and explain many parts. I, treading in the steps of *Constantinus Varolus,* shall take a quite contrary Course, yet such as is true and accurate, beginning at the lower part of the brain and so passing to the uppermost: and I shall afterward propound the order of parts from top to bottome, for their sakes that will needs follow the vulgar and common way of Dissection; where also a third way of Dissection shall be propounded.

See the Figure of the Section in the Manual of Nerves.

The beginning of the Spinal Marrow.

Beginning therefore at the lowest part of the Brain, we meet first with the *beginning of the lengthened Marrow*; the progress whereof because it is contained in the Vertebra's of the Spina or Back-bone, therefore it is termed *Spinalis* and Dorsalis, *Medulla,* the Spinal or Back-marrow.

An Objection.

And if any one shall think we ought therefore to begin with the brain, because the Spinal Marrow is said to take its beginning therefrom;

The Answer.

we answer, that we make the Marrow both as it is within the Skull and in the Back-bone, to be the beginning rather of the brain; and that the brain being divided into two parts, is as it were a certain double process or production of the Marrow it self.

A new Opinion of the Author, that the Marrow is the Original of the brain.

A proof hereof.

Which is yet more manifest to those that behold the Anatomy of Fishes; for there the Head and Tail of the Marrow, is very great, but the process of the Marrow, or the brain is very little: the Cause whereof is, that Fishes use motion more then sense, intimating that the brain or barke contributes more to sense, and the Marrow it self to Motion. Hence Fish are dull of Sense, but very nimble in motion. And according to this opinion of ours that saying will be verified, than an hard body is fittest for motion, and softer for sence.

The FIGURES Explained.

This TABLE presents the fourth Ventricle of the Brain, the Brainlet, and the *Corpus Callosum,* in several Figures.

FIG. I.

AA. *The Brainlet or Cerebellum and its Globes.*

B. *The Worm-like process of the Cerebellum or Brainlet.*

CCCC. *The processes of the Brainlet, which make the bridg of* Varolius.

D. *The beginning of the spinal Marrow.*

EE. *Two roots or smaller Processes of the spinal Marrow arising from the Brainlet.*

F. *The fourth Ventricle likened to a Pen.*

GG. *A portion of the Brain cleaving to the Brainlet.*

FIG. II.

AA. *The inner whiteish substance of the Brainlet.*

BBB. *The outer and more duskish substance compassing the white about.*

CCCC. *An Elegant structure of the Brainlet Representing the branchings of Trees.*

FIG. III.

AA. *The appearance of the brain cut off in the middle as far as to the Ventricles.*

BB. *The corpus callosum drawn a little to the left side.*

C. *A portion of the Sickle turned backwards.*

DD. *The right fore Ventricle uncovered above.*

EE. *The left Ventricle open in like manner.*

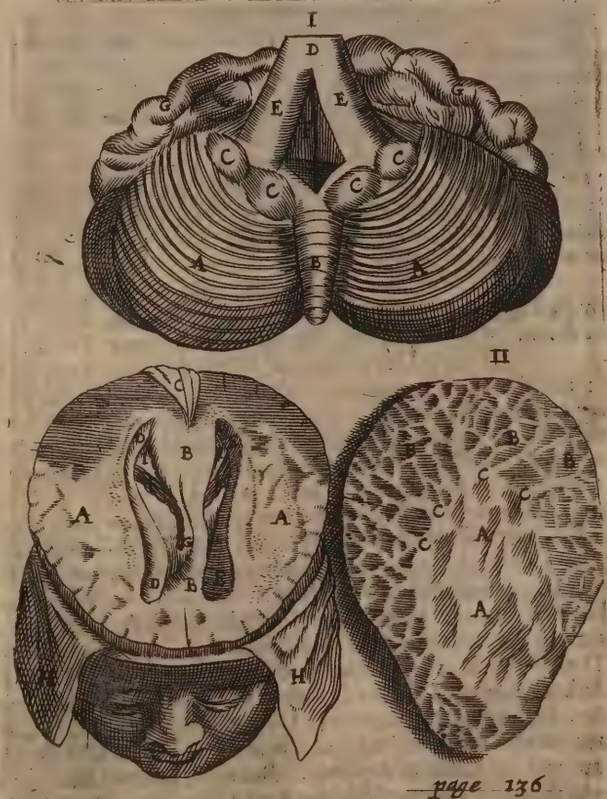
FF. *The Plexus choroides.*

G. *A portion of the Speculum or Septum Lucidum.*

HH. *The dura Mater drawn away on both sides.*

II. *The two Thighes or portions of the Fornix.*

The IV. TABLE.



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The *lengthened Marrow* ariſes as ſome conceive from the brain alone, according to others from the Brainlet or Cerebellum. But it hath both (to ſpeak now at a vulgar rate) for its beginning.

For it ariſes from four Roots or Foundations; two of which are greater from the fore-part of the brain commonly ſo called, two are leſſer from the inner part of the Brainlet or petty Brain. From theſe united, the ſpinal Marrow ſeems to be conſtituted. But it is peradventure a more true opinion to think, that thoſe originals are proceſſes of the Marrow it ſelf, as was ſaid before.

The *Subſtance* of the *Medulla oblongata* or lengthened Marrow, is a little harder then that of the brain.

The ſpinal Marrow divided. One part thereof is within the *Skull*, four Fingers breadths above the great Hole of the Hind-part of the Head. Another and the longeſt part thereof is *without the Skull* in the Vertebra's, from the firſt of the Neck to the laſt of *Os ſacrum*.

Its Figure is longiſh and round, The Scripture calls it the Silver Cord. In its beginning it is thicker and larger then elſewhere.

Another diviſion. It is further divided into the *right* and *left* part, even as the brain is, by the *pia Mater* which immediately inveſts the ſame, which may be ſeen in the Marrow of an Oxe indifferently boyled. Hence there may be a Palſie of only one ſide of the body.

Another diviſion. Now it is divided into many little Cords as it were, about the ſixt and ſeventh Vertebra of the Cheſt: and if the ſpinal Marrow of a body newly dead, be preſently plunged in cold water, and a ſeparation of theſe cords made, you may ſee the ſhape of an Horſes tail, (eſpecially towards the end) divided into many long Hairs: ſo that according to *Laurentius*, the Nerves alſo of the Back and Loyns, do ſpring from the Marrow of the Neck.

The Coats of the Marrow. It is covered with a tripple *Membrane*, the firſt which immediately covers it, is from the *pia Mater*.

The *ſecond* is from the *dura Mater* and cleaves to the former, Which two, according to the Obſervation of *Spigelius*, are not ſeparated any diſtance one from another, as they were within the Skul, but touch one the other.

The *third* being external ſprings according to *Galen* from a ſtrong Ligament, which binds together the forepatts of the Vertebra's, and in the hinder part ends into a ſtrong Coat, leaſt in bending or extending the Back-bone, the Marrow ſhould be hurt.

A thick and clammy humor is poured round about this Coat, to moiſten the ſame.

Afterwards the Marrow is ſhut up in the Vertebræ, leaſt it ſhould be hurt (as the brain is ſhut up in the Skul) ſeeing it is a noble part, and the original of the Nerves. Therefore the Ancients called the Cavity of the *Spina* or Back-bone *Hieran Surigga*, the holy Pipe.

In the beginning of this Marrow, while it is yet in the Skul, there appears ingraven.

A noble Ventricle in the Marrow. An *Hollow Cavity*, which *Galen* calls the Ventricle of the Brainlet; others call it the fourth Ventricle of the brain, though it is not in the brain. But I ſhall term it the *noble Ventricle* of the Marrow.

This is moſt ſolid, moſt pure, moſt ſubtile, but leaſt of all, for it containes a matter of greater force and faculty then the reſt, as *Galen* ſaies.

And becauſe, after a ſtraight even progreſs, it is widened on each ſide, and ſharpened afterwards into a point, becauſe of this ſhape tis called *Calamus Scriptorius*, the *Writing Pen or Quil*.

The cover of the noble Ventricle is from the Brainlet. Now from the Cerebellum or Brainlet, which is joyned to this Marrow, another and middle half of this Ventricle is conſtituted, as it were a cover; ſo that all this Cavity is between the brainlet and *Medulla oblongata*, or production of the Marrow, but the cheif Cavity is the lowermoſt, which is in the Marrow.

The true place where Animal Spirits are generated according to our Author. The *Uſe* of this Ventricle I hold to be this, viz. that it ſhould be the place where Animal ſpirits are Generated and Elaborated. For this Ventricle is 1. The moſt pure and ſubtile. 2. It hath a Cavity ſufficient for that purpoſe. 3. It is ſeated in ſuch a place, that it can poure forth Animal ſpirits into all the Nerves round about it. And therefore *Herophilus* did rightly judg, that this was the moſt principal Ventricle.

A Proof. Nor can I deviſe how it came to paſs that certain learned Men could not ſee theſe weighty Arguments, who have written without cauſe, that I aſſigned the Generation of Animal Spirits to the *Calamus Scriptorius*, without any reaſons moving me thereto.

Now muſt we think with *Spigelius*, that this Ventricle did only reſult by conſequence, out of the round particles of the Brain, touching one another without any deſign of Nature: for Nature doth nothing to no end, no not when ſhe ſeems moſt of all to do ſo.

Others conceive that the Animal Spirit is bred in the fore Ventricles of the Brain.

But they are full of Excrements, whoſe receptacles they rather are, as appears by the *Glandula Pituitaria* unto them, and in that they are often found filled with Flegm, and abundance of water.

The preparation of the Animal Spirits where it is? Others in the *Rete Mirabile*, others in the *Plexus Choroides*.

But in theſe we hold the Animal Spirit is prepared, but not Generated, For nature is wont to provide intertwinings of Veſſels for the preparation of any matter: and ſeeing theſe Veſſels are ſo ſmal, how can it be generated in them, eſpecially ſeeing ſo many Excrements of the brain flow through the Ventricles.

Others will have them to be wrought in the ſubſtance of the brain. Others in the lengthened body of the ſpinal Marrow. But the Generation of ſo ſubtile a Spirit, did require ſome Cavity, which is alſo allowed to the Generation of the vital Spirits.

For which cauſe ſome have been induced to allot the making of the natural ſpirit to be in the right Vencle of the Heart, becauſe there is no Cavity in the Liver.

I am therefore of opinion that the Animal Spirit is prepared in the *Rete Mirable*, and yet more in the *Plexus Choroides*, and that is generated and wrought up in this Cavity of the *Medulla Elongata*, or in the noble Ventricle; and afterward, as much of it as not derived into the ſpinal Marrow and the Nerves of the brain, is preſerved and retained in the whole brain, as in a Store-houſe.

This Marrow the beginning of all Nerves.

The *Use* of the lengthened and spinal Marrow, is to be the original of all the Nerves. For from that part thereof within the Skull, those Nerves arise which are commonly attributed to the Brain, being usually reckoned to be seven pair. But from the longest part thereof which is in the Backbone, Anatomists do reckon thirty pair of Nerves to arise, *viz.* as many as there are holes in the Vertebræ.

Mean while we must not so understand the matter, as though only so many branches or Cords did thence arise. For every Nerve arises with many little strings or Fibres, which going out at the hole of any Vertebra, are there joyned together by the Membranes, as if the Nerve came out of one branch.

Chap. V. *Of the* Cerebellum *Brainlet, Or Petty-Brain.*

The Brainlet what it is?

THe Brainlet being as it were a little and private kind of Brain, is a certain smaller portion, placed under the Brain in the lower and after-part of the *Occiput* or Hinder-Head: In Brutes it takes up commonly the whole Region of the *Occiput*.

It hath the same Substance, *Consistency*, *Colour*, Motion, &c. with the Brain.

Its Structure.

In the *Turnings* and *Windings* it differs from the Brain. The brain hath sundry Circumvolutions with out any Method or Order; the Brainlet hath circular and ordinate ones, stretched one over another like Plates. They are differenced partly by interposed Vessels, partly by the pia mater, which being separated, the several Circles may be taken out after another.

The inner *Substance* is various, whiteish and Ash-coloured, which distributed certain Vessels as it were.

The *Vessels* interposed betwixt the several plates, are carried through the pia mater like nets, which according to the accurate Observation of *Francis Sylvius*, arising from the Branches of the Arteria cervicalis, do at last end into the fourth Ventricle.

It is *constituted* chiefly of two lateral parts, on each side making a Globe as it were.

It hath two *Processes* or Excrescences, termed *Vermiformis* or *Worm-like*, because they are variously orbiculated, and consist of many transverse portions, coupled with a thin Membrane. Their Extremity being thin and convex, is as big as a small tare.

And they are *situate* at the seat of the noble Cavity, one before, the other behind.

About the hinder-part of the Trunk of the Spinal Marrow, in the Circumference of the noble Ventricle, out of the same brainlet there proceed two other globous processes, sometimes two of each side, sometimes three. Those are greatest which are seated by the Vermiformis, the rest are smaller. *Varolius* calls it the bridg of the brainlet.

See Tab. 4. Fig. 1.

The *Use* of all the Processes is to hinder the noble Ventricle from being obstructed, by pressure of the brainlet. *Laurentius* saies they help the motion of the Ventricles like a Valve, because the Vermiformis being shortned opens the way, which goes from the third to the fourth Ventricle; when it is extended it shuts the Chink, least the Spirits should go back into the upper Cavities. *Riolanus* dissents but little from him, for he will have it to open and shut the entrance of the fourth Ventricle. But it is not moved of it self, because, as the brain, so is it void of any proper motion, unless you assign it to the Vessels or pia Mater, which are very small, or at least to the neighbouring Animal Spirits.

Now I believe the use of the bridg is, to combine and keep in compass the Circles of the brain, and as a bulwark to defend the noble Ventricle. And therfore it would more properly be called a Sconce or Fence, then a bridg.

The Use.

The *Use* of the brainlet is the same with that of the brain. But *Galen* would have it to be the Original of the hard Nerves; which is false. For no Nerves have their Original from it.

Chap. VI. *Of the rest of the Parts observed in the Brain; viz. the Rete mirabile, Glandula pituitaria, Infundibulum, Ventricles of the Brain, Corpus callosum, Fornix, Plexus, Choroides, Glandula pinealis.*

THe precedent parts being considered, we must come now to those things, which are presently visible, about the Conjunction of the Optick Nerves, such as are; the *Rete mirable*, *Glandula pituitaria*, and the *Infundibulum*.

Rete mirabile

The *Rete mirable* or *wonderful Net*, which some call *Plexus retiformis*, is so called by reason of its artificial and wonderful structure, for it shews like many Nets heaped together. Now it hath another structure in Calves and Oxen, in which Creatures it is also more manifestly discernable then in mankind, though we must not say that it is not in Men as *Vesalius* doth, though hard to discern. I remember nevertheles that it hath been wanting.

Vesalius his Error.

This Net *lies under* the Basis of the Brain, encompasses the Glandula, at the sides of the Cavity of *Os Sphænoides*.

It consists (not of the Nerves of the third Conjugation as *Volcherus* would have it, but) of the Carotick and Cervical Arteries, carried up from the Heart, to the Basis of the Brain, which convey blood and Spirit in to this Net.

Riolanus places the *Rete mirabile* at the same Basis of the Brain, *viz.* The off-spring of the *Plexus Choroides*, which creeps through the former Ventricles.

The *Use* of this *Net* is, that therein the blood and vital Spirit may be a very long time detained, that the first preparation towards the Generation of Animal Spirits may there be made. Also *Walæus* hath observed that this Net doth consist of smal twigs of the jugular Veins; that they may doubtless carry back such blood as is superfluous after the preparation of the Animal Spirits.

Glandula pituitaria.

The *Glandula pituitaria* or *Rheum-kernel*, is so called from its use, because it receives

Its Seat. receives the Excrements of the brain out of the Ventricles through the Funnel. And therefore it is *placed* at the end of the Funnel in the saddle of the *Sphænoides*. *Galen* calls it barely *Glandula*.

Its Figure. On the *upper-side* it is hollow, *beneath* bossie or bunching.

Its Substance. Its *Substance* is harder and more compact then that of other Kernels.

Its Use. It is *cloathed* with the *Pia Mater*. Its *Use* is the same, with that of other Kernels, *viz.* by its drinking spungy flesh to receive grosser Excrements (for the thin Vapor out at the Sutures) collected in the Ventricles of the brain, many times in great quantities. For the brain being of great bulk, did need much Aliment, and therefore it breeds many Excrements, especially when it is in any measure disordered. These Excrements the Kernel doth sometimes cast into the Palate of the Mouth, and sometimes suffers them to drain away by the holes in the basis of the Skull.

The Brain ful of Excrements.

Others suppose the use of this Kernel to be, to shut the Funnel, least the Animal Spirits should go forth. For just over the *Glandula Pituitaria* or Rheum-Kernel, is

Infundibulum or *Funnel*, so called from its shape, for above the Head thereof is large, the lower part is a long and strait pipe. Others call it *Pelvis* the Basin, which words doth more properly belong to the Head, or beginning of the Funnel then to the whole body thereof. *Infundibulum.*

The *Funnel* therefore is an Orbicular Cavity (sometimes triangular with sharp or blunt Angels) made of the *pia Mater*, where it ingirts the basis of the brain. Its beginning is large, at the hole of the third Ventricle, as they call it; through which the Excrements are packt away out of the Ventricles into this Funnel.

Riolanus informs us that it hath four little pipes, which distil Rheum or Phlegmatick serum through the four holes resting upon the *Sellæ Sphenoideæ*.

Its of a dark *Colour*, and if you open it you shall find it full of thick Flegm.

The FIGURE Explained.

The Fornix being removed the Glandula Pinealis is here to be seen as also the third Ventricle of the Brain, which is in the middle between the two foremore Ventricles.

AA. *The Brain cut smooth off through the middle.*

B. *The Fornix took away and turned back.*

CC. *Its Expansions or hinder Thighs.*

DDDD. *The bottom of the right and left Ventricles, wherein the Vessels appear before.*

EE. *Their Walls or Sides.*

F. *The foremore hole of the third Ventricle, which some call* Vulva.

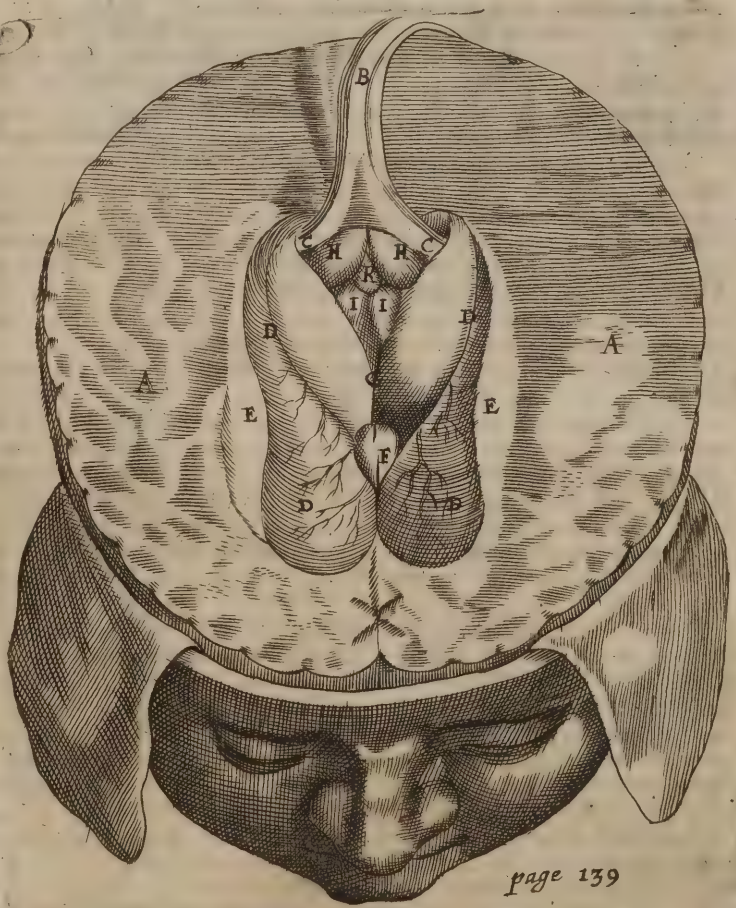
G. *A chink denoting the third Ventricle.*

HH. *Bunchings of the Brain called* Nates, *the Buttocks.*

II. *The Protuberances or bunchings called* Testes *the Stones.*

K. *The Glandula Pinealis or Pine-kernel-shap'd Glandule.*

The V. TABLE.



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Two little whiteish Kernels or Portuberancies of the brain are placed before this passage, which are to be seen, the brain being turned upside down, there where the Funnel receives wheyish Excrements out of the Ventricles.

These things being thus handled, the *Original of the Nerves* follows in course the Section to be observed, which every where arise from the Marrow: of which I shall speak in our Manual of the Nerves.

The

The *Ventricles* or *Cavities* of the Brain do follow.

Theſe according to the common manner of Section, beginning from above, are thought to be *three*: two *foremore and uppermore* as they call them, and *one in the middle*, to which ſome add a *fourth*, of which we ſpoke before.

But if diſſection be made after the new manner, beginning from beneath; there appear only two, ſo that the third is common, being a portion of the other two.

The Authors opinion that there is but one Ventricle of the Brain.

I conceive that *there is but one Ventricle of the brain*, which is in the middle, but the beginning thereof is divided into two; or there are two proceſſes, which receiving the Excrements, carry them into the middle it ſelf, which they call the third. For there is one continued Cavity of the brain, and the two Ventricles ſo called, do end into a common Cavity.

Mean while, becauſe this and that part of the Cavity ſeem diverſly formed, ſome diſtinction may be allowed for Doctrins ſake.

The foremore Ventricle deſcribed.

Thoſe *two Ventricles* which are ill termed the *foremore* and *uppermore* (becauſe they conſiſt alſo in the *hinder* and *lower* part of the Brain, perhaps they might better be called the lateral Ventricles, and with *Veſalius* the right and left) are the largeſt of all, crooked, full of windings, Semicircular, and cloathed with the *pia Mater*.

They are commonly and not unfitly liken'd to the Moon when ſhe is in the Wane; although they are hardly ever demonſtrated to be ſuch in diſſection. But ſeeing they are both oblong, and very large in their hinder part, they may alſo be likened to Horſe-ſhoes. This round form of the Ventricles was firſt diſcovered by the moſt accurate *Fr. Sylvius*, and after him I have often demonſtrated the ſame. But if you would find the true Figure, you muſt cut the brain deep towards the Skul, or the Temples, on each ſide, becauſe it is deeply ſunk into the *Corpus Calloſum*. For that part of the Ventricles towards the *Septum lucidum* is higher, and that which is towards the lateral part of the Skull is lower. The foremore and deeper parts, are near to the Mammillary proceſſes, and if we believe *Piccolhomineus*, *Bauhinus*, *Riolanus*, they are in ſome manner tranſpaſſable, eſpecially in elderly perſons.

Moreover they run out in their hinder part by a ſtraight Courſe, where they form a Cavity which is ſomwhat round, not unlike the Finger of a Glove; this I remember hath been ſomtimes wanting.

Moreover it is to be noted, that theſe Ventricles do environ the lateral and hind parts of the Roots of the Spinal Marrow, which alſo, under the *Plexus Choroides*, a part of the brain being wreathed and attenuated inwards, and upwards making the Concameration of the Ventricles, doth embrace with a ſelvidge as it were and a Fringe or lace, which the praiſe worthy *Sylvius* wont ſo to call for likeneſs ſake, it being knit to the was foreſaid roots by exceeding thin threds. If gently lifting up the Plexus, you ſhall remove this lace from the Root, you ſhall find little Arteries creeping through the lower ſurface of the Ventricle, continued to the Net-like Coronet of little Arteries inveſting the root; by help of which, this Lace ſeems to ſtick more cloſe to the Root.

But here you ſhall obſerve, that there is an eaſie outgate for the Humors contained in the ſaid Ventricles, which may deſcend down along the ſpinal Marrow.

Corpus Calloſum.

They are therefore formed, not in the Brain, but in the marrow, where they call it *Corpus Calloſum*, becauſe the ſubſtance is there harder like a *Callus*, where the Ventricles ſeem to reſt upon the two foremore Extuberancies.

The Conformation of the Ventricles of the Brain.

The Conformation of the Ventricles of the brain, which all cannot eaſily diſcerne, I have by Anatomical Inſpection and the Guidance of *Sylvius*, learnt to be thus.

Two Roots of the Spinal Morrow do penetrate a good depth into the ſubſtance of the brain; to the upper and former whereof, eſpecially where it looks inward, the brain being continued (now I mean the whiteiſh and Aſh-coloured part by the term Brain) it ſpreads it ſelf every way, eſpecially outwards and backwards and by little and little wreathes and contracts its lower extremities inward and upwards, till at laſt being attenuated, it doth on all ſides embrace the Root of the ſpinal Marrow with a lace, a little below the place where it ſprings therefrom, as was ſaid before; and ſo forms the lateral Ventricles.

But in the foremore and inner part, and whiteiſh ſubſtance aſcending from each Root, and making one body cal'd *Corpus Calloſum*, it is carried back; and covering the middle diſtance between the Roots, which is the third Ventricle, and the wide mouths of the lateral Ventricles opened thereinto, framed by it ſelf, it makes the Fornix, Arch or Vault; and is continued to the hinder and inner part of the Limbus or edge of each Ventricle.

Regius adds many pores in the Ventricles, looking into the Fiberkies of the ſubſtance of the brain, in which the Animal ſpirit is bred. But thoſe pores and Fiberkies are inviſible to the Eyes of Anatomiſts.

Septum lucidum.

They are diſtinguiſhed by a looſe and wrinkeld Partition-Skin: which if it be ſtretched out and held againſt the light, it ſhines becauſe of its tranſparency, and is therefore cal'd *Septum lucidum*: which ſome will have to ſpring from a moſt thin portion of the brain it ſelf, others from the *pia Mater* doubled. But the former opinion is truer, which you may perceive, if after the manner of *Sylvius* having removed the brain and ſickle of the other ſide, you ſhall ſearch the Ventricle of the oppoſite part, and ſhall lift up that part of the brain which is continued with the *Corpus Calloſum*, at the Orifice of the third ventricle; for then it may eaſily be ſeen, and diſcerned to be a ſmal portion of the brain.

Fornix.

The lower, whiteiſh part, where the ventricles are joyned, is termed

Fornix the Arch, or *Teſtudo* the Belly of a Lute, being of a Triangular Figure, conſiſting of three ſhanks, one before and two behind. In the common Method of Diſſection, this body is ſuppoſed to be ſpred out over the third ventricle, and to lie beneath the *Corpus Calloſum*.

Under the *Fornix* according to the obſervation of *Sylvius* the *Chevoides plexus* of both ſides, is immediately carryed, tending towards the *Glandula pinealis*; under which *Plexus*, in its upper part, the two Roots of the ſpinal Marrow grow together; ſo that here the *Teſtudo*, is not ſeated immediately under the third ventricle.

The

The FIGURE Explained.

This Figure preſents the left Ventricle of the Brain, being bent back, as it is repreſented in the fift Figure.

a. *The right Ear.*
b. *The left Ear.*
cccc. *The bone of the Forehead.*
dd. *Part of the Skin of the Head hanging down on either ſide.*
eeeeeee. *The dura Mater of both ſides hanging down.*
ffffff. *The Brain according to the paſſage of the left Ventricle, divided from that part which lies over the Root of the ſpinal Marrow, and turned backwards.*
ggg. *Part of the Brain reſting upon the ſpinal Marrow.*
hh. *A great chink of the Brain going over the Root.*
iiiiii. *The inner face and form of the left Ventricle reſembling the ſharp corner'd Moon.*
k. *The Cavity of the Ventricle like a Gloves-finger.*
l. *An orifice going into the third Ventricle.*
mmm. *The lace ſticking to the Root of the ſpinal Marrow*
nn. *The lace removed from the ſaid Root.*
ooo. *The Plexus Choroides.*
ppp. *The Root of the ſpinal Marrow raiſed up.*
qqq. *Veſſels creeping up and down the inner ſurface of the Ventricle, and ſpringing for a great part, from the ſmal Arteries which compaſs the Root.*
r. *The Septum lucidum.*

The VI. TABLE.

The third Ventricle. The third Ventricle commonly ſo called, or the long Chink, is the meeting together of the Ventricles aforeſaid, which is formed in the Centre, as it were of the Marrow of the Brain, by reaſon of the Conjuction of two round Trunks proceeding out of the Brain. It hath in it two paſſages, the firſt foremore, going downwards to the Glandula pituitaria, that it may there void its Excrements: the other is hindermore, cloathed with a Membrane; which hole ſome call *Anus*, the Fundament; it goes beneath the Buttocks to the noble Ventricle, that the prepared matter of the Animal ſpirits, may paſs into the place and Womb as it were of their Generation.

The Anus, what it is? This hole is nothing elſe but a ſpace ariſing upon the mutuall contact of the four Trunks of the ſpinal Marrow,

The Nates and Teſtes. Now the *Nates* or *Buttocks*, and the *Teſtes* or *Stones* are four Orbicular prominences, which they ſay are in the Brain, which is falſ. They call the two portions of the Roots of the Medulla oblongata, which ariſe from the Brainlet, Nates; and thoſe two little ones of the Roots from the Brain, they call *Teſtes*. And theſe parts are lower, the other upper.

Theſe differences, as *Fr. Sylvius* notes, between the *Teſtes* and the *Nates*, have place in Brutes rather then in Men; for the Men they are commonly equal, and many times the *Teſtes* are the bigger.

Penis. Vulva. But it is a trifling peice of buſineſs to impoſe ſuch Names as theſe; as alſo when they call the *Glandula pinealis*, *Penis*, and a certain long ditch between the Eminences they term *Vulva*.

The Plexus Choroidis, what? Between the fore-more Ventricles ſo called, and the Seat of the Teſtudo, there is, the Plexus Choroidis or Reticularis ſo called, being a contexture of very ſmal Veins and Arteries, ſent partly from the Arteries, partly from the Veſſels of the dura Mater in the fourth Ventricle. There is a glandulous ſubſtance interwoven within this Plexus, and a portion of the pia Mater. The Plexus Choroides being truly glandulous, does receive a little branch of the Carotick artery, which pierces into the lower part of the brain, which ends about the Glandula pinealis, where it branches up and down through the lower Surface of the Ventricle.

The *Uſe* hereof is the ſame with that of the Rete mirabile.

Glandula pinealis. At the beginning of that hole, which paſſes from the middle Ventricle into the noble Ventricle, there is placed a certain *Glandule* or *Kernel*, termed *Pinealis* the Pine-kernel Glandule, becauſe it is faſhioned like the Kernel of a Pine-apple. The Greeks call it *conarion* or *ſoma conoides*, ſome term it the Yard of the brain.

It is of an hard substance, of a yellowish and somtimes dark colour, and is covered with a thin Membrane. In Creatures newly kil'd tis large, in old karcasses, being melted it is scarce apparent, or is very small, as also in men, whose brains cannot be opened whil'st they are warm. And therefore they say it spends like Camphire exposed to the air, being also partly melted, as Salt is in a moist place.

According to the Observation of *Sylvius* a *nervous little string* does fasten this Kernel as it stands betwixt the Testes.

Who also observed more then once certain granes of sand in this Kernel, and somtimes also a little stone as big as the fourth part of a pease, and somwhat round.

The *Use* of this Pine-kernel is like that of other kernels, and especially to help the distribution of Vessels through the brain. Some will have it placed like a Valve before the hole which passes into the fourth Ventricle.

Des Cartes and his Followers *Meyssonerius*, *Regius*, *Hogelandius*, do conceive that this Kernel being placed in the middle of the Ventricles, which when a man is awake are distended with Spirits perpetually, does 1. Receive the motions of all Objects. 2. That the Soul in this part alone by these motions, does apprehend all external sensible Objects, and all the Ideas proceeding from the five Senses, as in a Centre, and discern the same, and does afterward by help thereof send Spirits into all parts; as in a smal Sphærical glass, all things are received in the same order in which they are either in a Field or Chamber.

For this cause *Meyssonerius* will have it to be of a *conick Figure*, because Individuals require more space then sorts or kinds of things. And that these Idea's are diversly moved by the motion of the animal spirit, but are alwaies found joyned by the Verb Est, and according to their equality or inequality, truth or falshood is compounded, being compared together like two Lines.

And that for this cause Infants do not presently speak nor reason, because the flappiness of their brain gives not passage to the Idea's. And that the overgreat and confused motion of these Idea's in the Pine-shap'd kernel, makes ravenings, as in persons drunk, phrentick, &c.

But many things there are which will not suffer me to embrace this new and witty Opinion. For

1. It is too small and obscure a body, to be able to represent clearly the Species of all things.

2. The Species of all Senses do not come hither, because the Nerves do not touch the Kernel.

3. It is placed in the Quarter of Excrements, whether they are purged out, by the third, and two foremore Ventricles, where the Species or Representations of things would be defiled.

4. The Species of things are perceived rather there whereto they are carried. But every sensory Nerve each in its place carries the Species to the beginning of the spinal Marrow, and therefore each in their place are judged and received by the Soul, in the beginning of the spinal Marrow. Moreover this Marrow is big enough, globous, hard, and of a brighter colour.

5. Several Idea's would be confounded in this little body. The Eye indeed being likewise very small, receives the Species or Representations of things without Confusion, but they are only the visible Species; whereas in this Kernel the divers Species of different Senses are to be received.

6. There is hence no open or known passage to the Nerves, as from the beginning of the Marrow, nor any communion with some Nerves of the external senses.

That the Ventricles of the Brain serve to receive Excrements.

The *Use* of the Cavities or *Ventricles* of the brain is, to be the Receptacles of Excrements, which is apparent.

1. From their Structure: for an hole goes from the Cavities to the Glandula pituitaria.

2. The Surface of the Ventricles is continually moistned with a watry Humor.

3. They are often found topful of flegm and watry moisture.

The order of the parts to be shewn in the new way of Dissection.

Howbeit in this new Section after the neck of the funnel is shewed with the Glandula: the Marrow being lifted up, first of all the Nates and the Testes are seen, and then the hole into the noble Ventricle; afterwards divers Nerves, the Ventricles of the brain with the hole into the funnel the Corpus callosum, the Fornix, the Plexus Choroides, and the Glandula pinealis.

The order of the parts in the old Dissection.

But in the old and common way of Dissection, these parts of the brain are shewed in order: The Corpus callosum, the Septum tenue, the two Extuberances, upon which the Ventricles rest; the two Ventricles, commonly called the foremore; the Fornix, the Plexus Choroidis, the third Ventricle, its two holes, the Glandula pinealis; and the brainlet being a little removed, the Nates and Testes the brainlet, the worm-fashion'd Processes, the noble Ventricle, the Pelvis, Glandula pituitaria, and Rete mirabile.

The order in the middle way of Dissection.

But if you will use the middle way of Dissection, familiar to *Fr. Sylvius*, thus you shall proceed. Take off the Skull as deep as conveniently you can. Then suffering the left side of the brain to remain untoucht, with its Membrane; begin your Dissection on the right side, first of all cutting asunder and removing the dura Mater; then take away some particles of the brain with the pia Mater, til you come to the Cavity of the Ventricle, and then follow both its upper and lower passage with your Dissection, as you see it done in the second Table. Separate the Limbus if you please, with a blunt probe, from the root of the Spinal Marrow, and shew it; though that may be more conveniently done in the opposite side of the Brain. The greatest part of the right side of the Brain being thus taken away, the upper and lower Cavities of the Sickle are to be shewn, as also the greater right side lateral Cavity, and the oblique descend of the upper Cavity thereinto, all which you have expressed in the foresaid Table.

The Dissection of the right side.

The Dissection of the left side.

These things being thus done, go to the left side, and therein first cut asunder the dura Mater, and remove it with the *Falx* or Sickle; then gently remove the left side of the Brain, into the place of the right side newly removed; and as you are doing this observe from Tab. 3. the Vessels going into the lateral Cavity, and how they rise up about the optick nerves, and are distributed into very many branches, creeping every where up and down the inner Substance of the brain, and especially the winding Surface thereof, til at last they end into the Carotick Arteries. Then search out that same notable chink or clift, between the windings,

dings, which is figured out in the Table aforesaid; and having cut the pia Mater, open the sides thereof a litlittle with a Spatter, that the branches of the Carotides may better appear, which are carried through the bottom of the turnings, with the Rudiments of new windings. But if, before you shall begin to shew the brain, you shall free the Carotick Arteries and the jugular Veins from the parts adjacent in the Neck, and bind them distinctly; and then by a Wound made in an Artery shall put in a crooked hollow probe and blow; the vessels disseminated through the whole brain wil swel, as being branches of the Carotick Arteries, until the air with the forced blood shall at length empty it self into the Ventricles: if by the foresaid hollow probe, you shall in like manner blow into the Ventricles, you will perceive their continuation and communion with the jugular Veins, by the swelling and distention of the said Veins; and will acknowledg that the Circulation of the blood, is not a little confirmed by this pleasant Spectacle.

An excellent Argument for the Circulation of the Blood.

Hence, returning to a farther search into the fabrick of the brain, and a wary Incision being made in the hinder part of the side propounded, search there for the larger Cavity of the Ventricle, and follow it with your Dissection to both the Ends; then turn back every way the outer part of that which is dissected, the middle part being kept upright, which rests upon the root of the Spinal Marrow, and is continued therewith, which is excellently well expressed in Table the sixt, in the Explication whereof, what you see set down, weigh in order.

Finally, taking away the Brain, observe again all the Cavities and that more distinctly; and then when you have seen the third Ventricle, the Funnel, the Glandula pituitaria, the pares of Nerves, after the usual manner; go back again to the Penis, Anus, Testes, Nates, &c. and examine the brainlet and its parts.

Nor will it be unprofitable, as often as a new occasion of Dissection is offered, so often to change the section in some part; for so it will come to pass, that you will alwaies observe somwhat which was unobserved before, or neglected, or not distinctly enough considered.

Chap. VII.
Touching the Forehead.

Why Mens Face, is void of Hair? THe Hairy part of the Head being explained, the smooth part or FACE follows, which in man is void of Hairs, otherwise then it is in Beasts, for Beauties sake; it is also called *Vultus* because of the judgment of the wil, which is Conspicuous of the Face.

Frons why so called? The upper part thereof, *viz.* the Forehead is termed *Frons a ferendo* from carrying, as some conceive, because it carries in it tokens of the mind: the rest thereof, from the Eye-brows to the Chins end, is the lower part, in which are many other parts, which are hereafter to be explained in order, external and internal, the Organs of the Senses, Muscles of the Eyes, Nose, Lips, &c.

Its Skin. The *Skin of the Forehead*, because it is moved, therefore it hath Muscles, which *Platerus* terms the signifiers of the Affections of the Mind. Now the *Muscles* of the Forehead do lift up the Eye-brows, and are thickest at the said Eye-brows.

Muscles.

They arise from the Skull, near the coronal Suture, and are *knit* at the sides to the temporal Muscles, but in the middle they are distinguished a little above, but beneath they are so nearly associated, that they seem to be one Muscle, and end at the Eye-brows. Yet I have observed in a large nosed person, that an Appendix of the said Muscles did reach to the Gristles of the Nose.

They have straight *Fibres*. Surgeons therefore must not cut them athwart, least they destroy the lifting up of the Eye-brows; but upwards, according to their length. *Hofman* after *Aquapendent* stands for oblique fibres, on the right side from the right hand to the left, on the left side from the left hand to the right. But this they do against Experience, ocular Inspection, and Reason. For the skin of the Forehead is by a straight course, either elevated or depressed by help of right fibres, which are the cause of straight motion. In the point of right fibres, we have the Consent of great Anatomists *Vesalius*, *Laurentius*, *Bauhinus*, *Platerus*, *Veslingus*, &c.

And because the skin of the Forehead grows close to these Muscles, therefore both the Forehead and the Eye-brows are moved.

Howbeit there are somtimes also two Muscles in the *hinder part of the Head*, which move the skin thereof, short, thin and broad, with straight fibres, ending above into a broad Tendon, and touching the hindermore Muscles of the Ears, in their sides. Some men that are furnished with these Muscles, can draw the skin of their Heads backwards.

Chap. VIII. *Of the Eyes.*

The Eyes why called Oculi? THe *Eyes* are termed *Oculi ab occultando* or *occludendo* from shutting or hiding, because they are hid under the Eye-lids; they are the Instruments of Sight made of Humors, Membranes, Muscles, Vessels, and other Parts.

Their Situation. They are *seated* in an eminent place like Watch-men, in boney Sockets covered with the Periostium for better Safeguards sake.

Their Number. They are in *Number* two, for the perfection of Sight, and that one being defective, the other may supply its place and office. Howbeit both Eyes see but one Object, at one and the same time, and not a double one, whether because the knowing and judging Faculty is one, as *Aquapendent* conceives, or because the Axle-tree of the two visual Pyramides, do pass along upon the same Surface of a plane, as *Galen* expounds the matter; or because of the exact similitude they have received from particular things from whence they came, the internal sense judging only one and the same species, as *Aquilonius* does philosophize. They are in Mankind very little distant one from another, both for the Nobility and perfection of their Action, and the Reception of visible species.

Their Shape. They are *round*; but a little longish, like bulbous Roots whereupon

Two *Angles* or *Corners* are made, at the Socket of the Eyes, which are termed *Canthi*; the *inner* and greater at the Nose, the *outer* and lesser at the Temples.

In

Its Parts. In and about the Eye, there are ſundry parts, ſome without the Eye, for ſafeguard or commodities ſake, as the *Eye-lids* with their *Hair* and the *Eye-brows*, alſo Caruncles in the Corners of the Eyes; other parts there are which conſtitute the Eye it ſelf, and they are *Fat*, *Muſcles*, *Membranes* and *Humors*.

The Eye-lids. *Palpebræ* the *Eye-lids* are parts which cover and ſhut the Eye, which cleanſe and putrifie the Cornea Tunica, and likewiſe by their overſhadowing render the Picture in the *Retina* more illuſtrious, according to the opinion of *Averrhoes*, *Varolius*. *Plempius*.

The are *made up* of the Skin, the Membrana carnoſa, Muſcles, a Coat, the Tarſi and Hairs: and therefore their ſubſtance is ſoft,

Whether the lower Eye-lid be moved? The *Eye-lid*, is either the *lower* which if we believe *Galen*, is of it ſelf immovable, ſave in ſome birds. Yet *Bauhin* and *Aqua-pendent* do aver that they are really moved, and *Fallopius* proves it by the example of a Sea-Calf, and any one may prove the ſame in a Looking-glaſs, wherein he may ſee his lower Eye-lid meet the upper. But either this motion is obſcure or we muſt ſay with *Veſalius* and *Sylvius* that the upper part of the circular Muſcle doth lift up the upper part of the Eye-lid, and that the lower part is drawn down, by the other part of the Muſcle, which notwithſtanding is not true, becauſe the ſtraight Muſcle lift up; or we muſt ſay with *Piccolhomineus* that they follow the motion of the Cheeks; or finally, the Orbicular Muſcles only moves the upper Eye-lid, and doth but embrace the lower, and knit it is a coupler. The other is the *upper*, which is moved and that moſt ſwiftly. ſo that we compare a quick motion to the twinkling of the Eye.

The Muſcles of the Eye-lids. Now they are moved upwards, that is to ſay are opened and lifted up by the *right Muſcle* which is leſs then the other. It ariſes about the Optick Nerve, and ends with a Tendon into the Extremities of the Eye-lid. They are moved downwards, that is

The Explication of the FIGURES.

This TABLE repreſents the Muſcles of the Eye in their natural Situation, and the Muſcle of the Eye-lid by it ſelf.

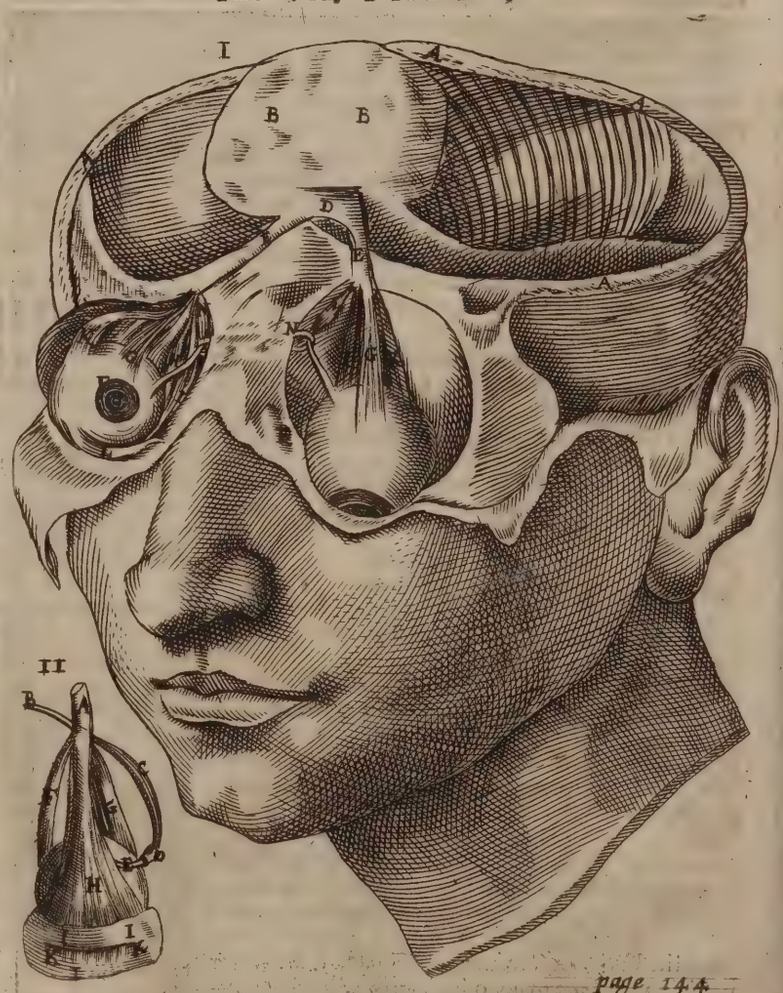
FIG. I.

AAAA. *The hollow part of the Skul cut off.*
BB. *The inner and whiteiſh portion of the Brain diſſected.*
CC. *The Brainlet or Cerebellum*
D. *The meeting and union of the Optick Nerves.*
EE. *The parting of the ſaid Nerves going to each Eye.*
F. *The Caruncula Lachrymalis drawn out of its place.*
GG. *The firſt Muſcle of the Eye called* Attollens.
H. *In the right Eye, ſhews the ſecond Eye-muſcle, or the Muſculus deprimens.*
II. *In both Eyes ſhews the Muſculi recti interni or Adducentes.*
KK. *In each Eye ſhews the recti externi or Abducentes.*
L. *The Muſculus quintus, or obliquus externus, is ſhewed in the right Eye.*
MM. *The ſixt Muſcle or the obliquus, internus, whoſe Tendon paſſes through the Pully,* N.
O. *Shews the optick Nerve in the right Eye.*
P. *The Cornea Tunica, in the midſt whereof is the Pupilla.*

FIG. II.

A. *The optick Nerve.*
B. *The Nerves which moves the Eye.*
C. *The Trochleatis Muſculus, whoſe Tendon,* E. *goes through the Pulley,* D.
F.G. *The Muſculi recti, internal and external.*
H. *The Muſcle proper to the upper Eye-lid, contained within the Socket of the Eye.*
III. *The Eye-lids cut out off.*
KK. *The Cilia, that is the Ends of the Eye-lids adorned with Hair.*

The VII. TABLE.



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to ſay are ſhut and covered, by a certain Orbicular or Circular Muſcle, which is every way half a Fingures breadth, ariſing from the Root of the Noſe, which afterwards runs back with circular Fibres, under the lower Eye-lid, through the outward corner, and ends above the upper Eye-lid, at the ſame place of the inner corner. *Spigelius* and others do divide it into the upper and lower Muſcle, becauſe each hath a different Nerve coming from divers places, and they obſerved that in the *Convulſio canina* ſo called, ſomtime the lower Eye-lid was ſtif, the upper being moveable. But no diviſion of this Muſcle can be diſcerned by the ſharpeſt Eye-ſight, the Fibres being every where continued, though the inſertion of the Nerves be different as it is in ſome other Muſcles, of the Noſe &c.

The Membranes. The *Membrana carnoſa* is thin in this place, together with the Muſcles, like another ſimple thin Membrane; and therefore *Ariſtotle* ſaid that the Skin of the Eye-lid was without fleſh, and being cut off, like the Fore-skin, it grows not again.

They are cloathed with an inner Coat ſpringing from the Pericranium, exceeding thin and ſoft, leaſt they ſhould hurt the Eyes, which they touch.

The *Extremities* of the Eye-lids are hard and Griſtley; but ſoft like ſmal Griſtles, and Semicircular, the

The Cilia, what? Greeks term them *Tarſous*, the Latins Cilia whereon the Hairs are faſtned (which ſome term *Cilia*) being ſtraight becauſe ſituate in an hard place, keeping all waies in a manner the ſame greatneſs hindering ſmal and light matters from falling into the Eye, and ſerving to direct the ſight which *Galen* proves from ſuch as have them fallen or pulled off, who can hardly diſcerne things afar off, eſpecially if they be of a dark colour, which *Montaltus* doth prove by the example of a youth at *Lisbon*.

The uſe of the Eye-brow. The Supercilia or Eye-brows, are Hairs growing at the bottom of the Forehead, above the Eyes, intercepting ſuch things, as fall from the Head that they may not light into the Eyes.

Caruncula a ſmal portion of fleſh, is placed at each great corner of the Eye, containing Humor to

Punctum lachrmyale moiſten the Eye; and it is placed over an hole bored in the Noſe-bone, which is called *Punctum lachrymale* (diſtinct from theſe two holes in the edge of the Eye-lids, which *Galen* call *Tremata*, and are moſt viſible in living bodies, eſpecially of ſuch as are inclined to weeping) leaſt we ſhould continually weep. But in an Oxe there is moreover a moveable Membrane, which can ſhut the Eye, though the Eye-lid be open, by help whereof Brutes wink and cover their Eyes, when they fear any thing ſhould fall into or hit them.

The uſe of fat in the Eye. In the ſpaces between the muſcles and ſundry Veſſels, there is fat, which heats, moiſtens, and ſo helps the motion of the Eye, and makes it round and even.

The Eye muſcles. The Muscles of Mens Eyes are *ſix*. Becauſe they have ſo many diſtinct motions: four ſtraight and two circular: all are *ſeated* within the Cavity of the Skul, and accompany the optick Nerve. All their Tendons being joyned together at the *tunica Cornea*, under the *Adnata*, do

Columbus his Error. make that Coat which *Columbus* call *Tunica innominata*, the *Nameleſs coat*, as if it had not been known to the ancients, whereas *Galen* hath made mention thereof, in his tenth Book *de Uſu partium* Chap. 2. & 8. though it be not properly a Coat, but only divers Tendons of Muſcles, nor doth it compaſs the whole Eye. Yet by ſome it is called *Tunica Tendinoſa* or *Tendinea*, the Tendinous Coat.

The firſt Muſcle of the Eye. The *firſt Muſcle* being the upper and thicker is called *Attollens* the *lefter up* or Superbus, the proud Muſcle.

The ſecond The *ſecond* oppoſite to the other, being the ſmaller in the lower part, is termed *Deprimens* the depreſſer, and *Muſculus humilis* the lowly Muſcle, becauſe it draws the Eye downwards towards the Cheek-balls.

The third. The *third* placed in the greater Angle is called *Adducens*, the *drawer to*, and *Bibitorius* the drinking Muſcle, moving the Eye inwards towards the Noſe.

The fourth. The fourth is called *Abducens* the drawer from, drawing the Eye towards the ſide of the Face to the ſmal cornerward; tis alſo termed *Indignatorius* the Muſcle of indgnation.

All theſe four Muſcles have the ſame beginning, the ſame progreſs and end: for the beginning of them all is acute, near the hole where the optick Nerve enters into the Socket of the Eye, from the Membrane wherof they do ariſe: they have all a fleſhy and round belly: their end is a very ſmal Tendon, as was ſaid, at the Cornea.

By theſe four acting together the Eye is drawn inwards, and is kept from ſtirring, which holding is by Phyſitians called *Motus tonicus*.

The fift. The *fift* is lean, round, ſhort, *oblique*, ſeated between the Eyes and the Tendons of the ſecond and third Muſcle, and aſcending by the outer corner of the Eye, to the upper part of the Eye, is inſerted into the *Cornea tunica* by the Region of the Iris. It whirles about the Eye obliquely downwards to the external Angle, or corner.

The ſixt or pulley Muſcle. The *ſixt* being the ſmalleſt of all, and having the longeſt Tendon, *wheels the Eye about* unto the inner Corner. For ariſing from a common beginning with the firſt four, it is carried right out to the inner Corner; there it paſſes through the Pulley, and aſcends in a right Angle to that place where the fift was inſerted. Tis called *Trochlea Muſculus* the Pully-muſcle, becauſe it wheeled about as it were through a Pulley which Pulley is a Griſtle in the Eye ſticking out, firſt obſerved by *Fallopius*, though *Riolanus* do alſo attribute the Invention thereof to *Rondeletius* who lived at the ſame time with him. Tis ſituate at the upper Jaw-bone, by the inner corner of the Eye, and therefore in the Cure of *Fiſtula lachrymalis*, the Surgeons ought to have a great care, leaſt they wrong this Pully.

Theſe two laſt are termed *Amatorij*, love Muſcles, and Circumactores, rowling Muſcles the upper and lower. *For by the help of theſe Muſcles lovers caſt Sheeps-Eyes one at another.*

A ſeventh Muſcle in Brutes. There is yet a *ſeventh* Muſcle in Brutes, which may be divided into two, three, or four.

This is a ſhort Muſcle, compaſſing the optick Nerve, fat coming between, and being fleſhy it is inſerted into an hard Coat.

Its *Uſe* is; to hold up the Eyes of Brutes which look down towards the Ground, and to enwrap the ſoft optick Nerve.

An *eigth* membranous Muſcle may be added, wherewith Brutes do wink.

Some Animals have no Muscles. *Scaliger* proved it by Dissection in Cats, yet *Casserius* pictures out the Muscle of a Cats Eye. A *Chameleon* indeed hath no Muscles, and yet moves his Eyes every way, and either of them backwards, and that by a wrinkled membrane furnisht with Fibres, as *Panarolus* does aver.

Vessels of the Eye. *Vessels* are sent to the Eye, a *Vein* from the Jugulars, an *Artery* from the Caroticks, disseminated through the Muscles, Fat, and Membrane.

The Nerves. The Eyes have the two first pare of Nerves, as they are commonly reckoned: The first is the *Optick* or *seeing* pare being thick and porous, carrying from the Brain the Faculty of seeing with the Spirit, or carrying the visible Representations of things to the Brain. It is inserted behind, into the Centre of the Tunica cornea, to which from the hard Tunicle or external Membrane it communicates a Coat, and passes more inward to the Centre of the Retina, into which its marrowy substance is spred abroad; and somtimes a portion of the vitrea tunica, sticks to the inner part of the Marrow. In Brutes it is inserted obliquely, and not into the Centre of the cornea tunica, but into the side. The second is the *Moving pare*, which goes into the Membranes, and sends a little Branch into every muscle. But touching these Nerves I shal discourse more largely in my Manual of the *Nerves*.

The Membranes of the Eyes but three. The *Membranes* besides the external and the conjunctive (which is common) are but *three* and the *Humors three*. And as in a Nerve, there is a threefold substance which enters the Eye: so these three substances do make the three Coats of the Eye. For the *first* Coat arises from the dura Mater; the second from the pia Mater; the third from the marrowy substance in the Brain.

Adnata Tunica. The Tunica *adnata alba* or *conjunctiva* is smooth and thin, arising from the Pericraneum. Some will have it arise from the Periosteum, and end at the Circle of the Itis, after it hath communicated a Coat to the Eye-lid. It is the outmost Coat of all, next the bone. *Hippocrates* calls it the White of the Eye.

Its Use. It fastens the Eye to the Socket and inner Bones like a Ligament.
It is of exquisite Sense.

The Seat of the Ophthalmia or Blearey'dness. It is sprinkled about with very many little Veins and Arteries, not appearing save when there is an Afflux of Humors, for then they swell and are very red as in the Opthalmia or Blearey'd soreness, which Disease is seated in the Part.

1. Tunicle of the Eye. This Adnata being removed, the first that offers it self, is the *Sclirotica* or *dura* so called, which arises from the dura Mater, and it is thick, stretched, equal, and dark on the back part. The forepart of this they call tunica *Cornea*, because it is polished and transparent like an horn: for it may be scaled into four plates, over which the Epidermis is placed, and involves the whol forepart of the Eye. It is next the sclirotica or dura, firmly cleaving in the hinder part of the *Choroides*, yet joyned with the Chrystalline in the middle, that it may separate the watry and glassie Humors.

Cornea.

2. Tunicle of the Eye. The second is called *Choroides*, because it is like the Chorion, and Vessels are sprinkled up and down. It arises from pia Mater, being from the first Original blackish, especially within, that the Idea's received in a dark place, might be the more illustrious. In Brutes it is of several Colours, somtimes watchet, &c. Under the transparent Cornea it is in men somtimes skie-colour'd, somtimes blew, or grey, which Colours are seen through the Cornea. This in its forepart is termed *Uvea*, by reason it is of the colour of a Grape, in which part it is thick and doubled: it is moveable and according to the diversity of the Object or Light, it is contracted and dilated, as we may very well discern in Cats. This forepart is also perforated in the middle, to let in the Species or Representations of visible Objects, where

The Pupilla. The *Pupilla* or sight of the Eye is formed, which in Mankind is round: in some Brutes of an oblong shape, or long and round. *Riolanus* hath observed the compass of this hole or the Crown thereof, being drawn with the point of a Penknife, to have been cut off orbicularly, which may better be seen in an Ox eye boyled, which makes him think this Circumference to be a distinct Membrane from the Uvea, since it hath peculiar fibres. But this is confuted by *Plempius*, and because the Verge of the uvea tunica hath divers colours, hence arises

Iris. The *Iris* or Circle, which *Galen*, *Casserius*, *Riolanus* reckon to be sixfold, and *Plempius* but threefold: a double narrow one at the White of the Eye, a third at the Sight true and larger, illustrated with a constant colour. This Circle is seen variously coloured, and where it makes the Iris, it is somtimes skie-coloured, otherwhiles fierie, grey, black, &c.

Ligamentum ciliare. From the Circumference of the Uvea, where its duplicated Membrane bends it self back to the Chrystalline, there arises a Ligament or *Interstitium ciliare* so called, which are certain then filaments produced out of the Uvea representing the black Lines of the Eye-lids, like Hairs, and they compass the Chrystalline humor, which by help of these is knit to the neighboring parts: it is moved with the Uvea being moveable. *Carteſius* will have its use to be to move the Chrystalline, that the Situation thereof may be changed, according to the various necessity of sight.

The third Coat. The *third* is the *Retina* or *Amphiblestroides* as the Greeks call it, that is the Net-fashion'd Coat, made of the inner substance of the Brain or of some Nerve spred out as it were, the pia Mater withal accompanying in the same, if we believe *Galen* and *Casserius*. Therefore this soft, and as it were snotty matter may be gathered together, compassing the vitreous Humor and its vitreous Coat like a Net. It is an exceeding thin coat, but more dark then lightsom, mixt with an obscure Redness, because the Species received, are here stopped and represented; yet is it a little snotty, with which Snot is somtimes white, for the illustration of the Species received. In my Judgment, it is the fliminess of the marrowy Substance.

Its *Figure* is semicircular, like a Mitre, and its sides are near the Chrystalline, for the distinct Representation of the Species.

Platerus saies it hath no Vessels; contrary to *Galen*, *Casserius*, *Sylvius* and others, and Experience it self: for the hinder part of the Choroides and the sclirotica tunica, have Vessels manifestly apparent in this Coat, and there they ought to be, that it may be nourished with its contents. This compassing yet farther becomes the *Aranea* or Chrystalloides, the proper Tunicle of the Chrystalline Humor, cloathing the fore and hinder part thereof, white, most thin and transparent, so that it is cal'd the *Looking-glass*.

Aranea.

I add

The Explication of the FIGURE.

The TABLE shews the Muscles of the Eye, the Tunicles and the Humors.

FIG. I.

A. *The horney tunicle with the Pupilla or sight to be seen through it.*
B. *The right Muscle that lifteth up the Eye.*
C. *The internal right Muscle or the Muscle drawing to, or shutting.*
D. *The right internal Muscle or the drawing from, or opening.*
E. *The right external or opening Muscle.*
F. *The internal crooked Muscle called* Trochlearis.
G. *The external oblique Muscle below.*

FIG. II. Shews the Muscles in a Sheeps Eye.

A. *The Optick Nerves.*
BB. *The seventh Muscle that is about the Optick Nerve proper to Beasts.*
CCCC. *The straight Muscles.*
D. *The trochlear Muscle.*
E. *The lowest oblique Muscle.*

FIG. III.

aa. The adnata tunicle in its place.
bb. The Cornea or horney tunicle.
cc. The uvea tunicle.
dd. The tunicle sclorotis.
ee. The hard Membrane of the Optick Nerve.
ff. The tunicle Choroides.
gg. The thin Membrane of the Optick Nerve.
hh. The Net-tunicle called Retina
ii. The marrowy Substance of the Optick Nerve.
l. The inward Marrow affixed to the Vitrea.
mm. The Chrystal tunicle.
nn. The Pupilla.
oo. The shineing part of the Cornea.
A. *The watry Humor.*
B. *The Chrystallina Humor.*
C. *The glassie Humor.*

FIG. IV. The adnata Tunicle separated from its place, with many Veins and Arteries.

FIG. V.

A. *The Nerve Optick taken from the dura Mater.*
BB. *The dura Mater going about the Optick Nerve.*
CC *The Sclerotis opened, through which the Uvea is seen.*

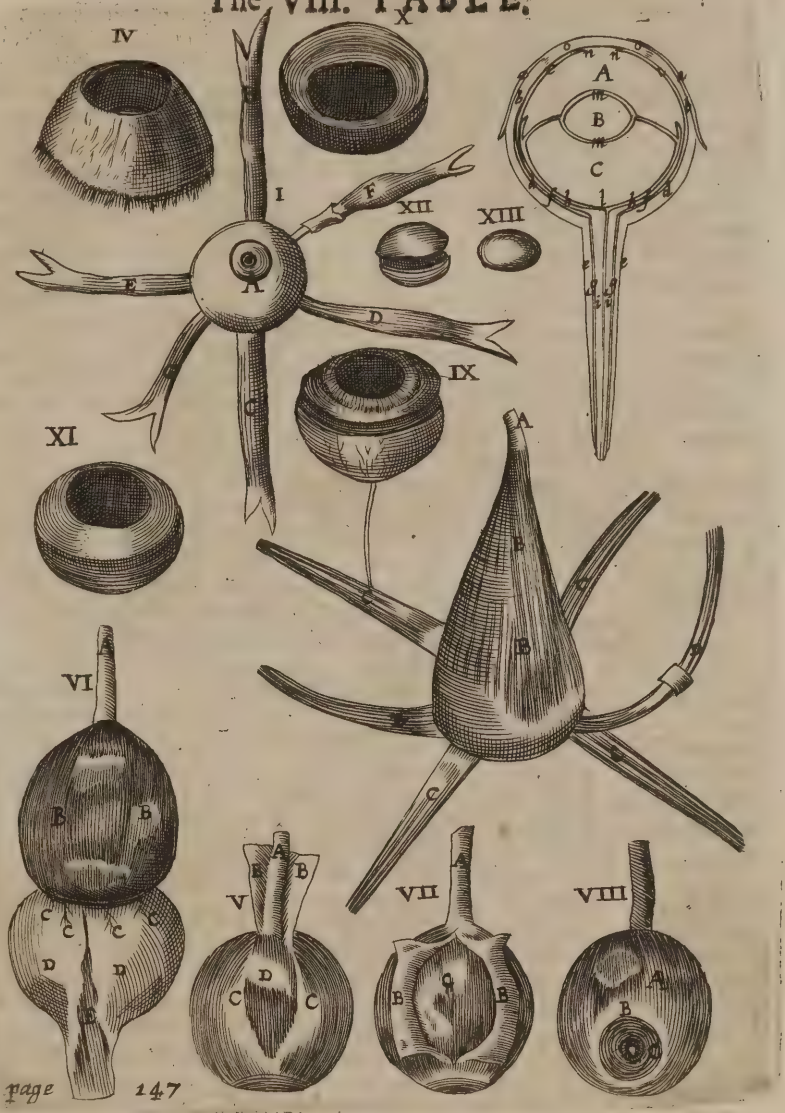
FIG. VI.

A. *The Optick Nerve covered only with the pia Mater.*
BB. *The Choroides taken from the Sclerotis.*
CCCC. *The Veins of the Sclerotis.*
DD *The Sclerotis turned inside out.*
EE. *The Rupture of the Sclerotis.*

FIG. VII.

A. *The Nerve Optick.*

The VIII. TABLE.



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BB. *The Uvea unfolded and separated in part from the Retina.*
CC. *Part of the Retina laid bare from the Uvea, made too obscure.*

FIG. VIII.

A. *The Retina laid bare.*
BB. *The White of the Eye or tunica conjunctiva.*
C. *The Cornea.*
D. *The Pupilla.*

FIG. IX.

The glassie tunicles with the Hairs of the Eye-lids.

FIG X.

The watry Humor thickned in the middle of which there is a hollow to receive the forepart of the Chrystalline.

FIG. XI.

The glassie Humor with the Christallina in the middle.

FIG. XII.

The Chrystalline tunicle.

FIG. XIII.

The Chrystalline Humor in its proportion.

I add

Vitrea. I add the *tunica Vitrea*, which covers the vitreous or glassie Humor on all sides, that it run not about, and separates it from the Chrystalline Humor. It is of exceeding smoothness and thinness, shed about the Humor like a thin Skin, not only in the convex part of the said Humor, but also in its concave part, where it receives the Chrystalline, where indeed it cleaves close to the Chrystalline Coat, but is different from it. It is furnished with many, but very little Veins, and the inner portion of the marrowy Substance of the Optick Nerve, cleaves to the Centre thereof. The form is such as that of the glassie Humor, large and convex behind, and concave before.

Humors of the Eyes. The Humors of the Eyes are three, the *watry*, the *glassie*, and the *Chrystalline*: of which the last is the most noble, and by some termed the Soul and *Centre of the eyes.*

The watry Humor. The *watry* because thin and fluxive like water, occupies the whole space between the Tunica cornea, and the fore part of the Chrystalline. *Riolanus* also proves that it is poured round about the vitreous Humor, and that all of it is contained within the whole *uvea tunica*; because the Eye being cut in the hinder part, water flows out as much as if it were cut before. But if the *vitrea tunica* be also cut with a large Wound, no wonder if water flow from thence, which *Plempius* also notes; not to say how easily the inner parts are broken, when they are rudely fingred. In the Humor Suffusions are made.

The watry Humor is no animated part, the other Humors are. This Humor is no animated part, but seems only to be an Excrement remaining after the Nutrition of the Chrystalline Humor: for it is both consumed in Diseases, and lost in Wounds of the Eyes; the other two humors are animated parts, seeing they have their proper circumscription, are nourished with blood brought Veinlets, when perished they are not restored, and are bred in the Womb: and the Chrystalline of the most pure lightful part of the Seed.

The *Use of the watry* Humor is to defend the bordering parts from driness: others add, that as a medium it serves to break the brightness continually flowing in, and to greaten the Representations of the Objects, being straitned in the Pupilla or Sight.

The vitreous or glassie humor. The *Vitreous* or glassie Humor is seen behind, like molten Glass, softer then the Chrystalline, then which it is nevertheless five times bigger, and twice as big as the watry Humor. It is round in its hinder part, plane before, but being concave in the middle, it makes an hollowness wherein the Chrystalline Humor is placed as in a Pillow. Its *Use* is not barely to nourish the Chrystalline, as *Galen* conceived, but to prepare and communicate Nourishment thereto. According to *Aquapendent* from whom *Riolanus* had the notion, that the light carried beyond the chrystalline may not return defiled by dark and other coloured tinctures, and so disturb the Sight. *Platerus* more rightly, that the splendid vitreous Humor might fill up a necessary space between the Chrystalline and the Retina, which *others* explain more clearly, that the glassie Humor may give a passage to the Species to the Retina, and may refract them from Perpendiculars.

The Chrystalline. The *Chrystalline* (which some call the icie because of its firmness) is so called from its exceeding bright and shineing colour, which it hath, being free from all other colours, that it may receive all colours, it is shineing, indifferently hard, round behind, with some longness, flat on the foreside: howbeit according to the sundry affections of the Eye, this form is variously changed.

Its *Use* is, to be the chief Medium of sight, as a glass held before the hole, receives the external species into a dark Closet, even so the Chrystalline Humor, both receives and collects the Species or Representations of things. And because the humor is transparent, the Species are not stopped therein, nor colours perceived, which most Anatomists have beleived after *Galen*; for otherwise there were no reason why they should not be as well perceived in the Cornea, and vitreous Humor, both transparent and animated. Therefore the sight is not primarily made in this Humor, but the Species are discerned in the *retina tunica*, because there they are stopped by a dark Body, as we seen on the Wall of a Chamber, when the Windows are shut.

Scheinerus conceives, that the Species which did represent all things the bottom upwards, are corrected and refracted in the Chrystalline Humor, so as to represent all things in their due posture. But according to the Observation of *Joh. Walæus*, *Fr. Sylvius*, and *Fr. Vander Schagen*, the Choroides, the Sclirotica, and Retina tunica, being taken away from behind, all things are seen by the Eye, and represented with the bottom upwards, very small in an Oxes Eye, somwhat greater in a Mans. *Plempius* proves the same by an Experiment of a glass Instrument filled with the three Humors, placed before the hole of the Window, where all things appear on the Wall with the wrong side upwards. And doubtless the Species must needs be represented with the bottom upwards in the Retina, otherwise we should see all things the wrong end upwards, and not right, which *Keplerus* hereby demonstrates, because in passion the Patients must be just opposite against the Agents.

Others will have it, that our Judgment corrects the depraved Figure, which discerns the just Magnitude of things by very small Species received. *Others* alledg the common Sense, which seeing the inverted species, behind and above the Cavity of the Retina, apprehends them in their true posture. Finally *others* say that a true Judgment is therefore made, because it is made by a right Line.

Chap. IX.
Concerning the Ears.

THe Organ of Hearing, viz. the EARS are either external or internal.

The *external* which are by some termed *Auriculæ* the Earlets, are in Mankind of a semicircular Figure, convex without, concave within.

The outer Ear is *divided* into the upper and lower part.

Names of the parts of the outer Ear. The upper is broader, and by some called *Pinna*, by others *Ala*. The lower is soft and hanging down, termed *Fibra*, *Auricula infima*, *Lobus*.

The outer Circumference of the Ear is called *Helix*, also *Capreolus*, because of its wreathed formed. The inner part opposite to the former, is termed *Scapha* or *Anthelix*. In the middle hereof is a large Cavity, the principal part of the external Ear, called *Concha*. But the Cavity near the *Meatus auditorius* or Hearing-passage, where Ear-wax is collected, is cal'd *Alvearium*. Towards the Temples there grows a certain eminency like a covering, which either receives or hinders

things

things that would go into the Eare, and is termed *Hircus* the Goat, becauſe Hairs grow thereon.

The Parts whereof the external Ear is compoſed, are either common, as the Skarf-Skin, the Skin, a Nervous Membrane, Fleſh, and a little Fat in the Lobe: Or Proper, as Muſcles, Veſſels, and a Griſtle.

Its Skin. The *Skin* is exceeding thin, cleaving to a little Fleſh with a firm Griſtle; and as in the Palms of the Hands a Nervous Membrane is firmly faſten'd thereto; by the ſenſe whereof it happens that cold water ſprinkled on the Lap or Lobe of the Ear doth cool the whole Body. In the Lobe it is ſo mingled with Fleſh, that it becomes thereby fattiſh, fleſhy and ſpungy: Hence the Lobe is ſoft and flexible, ſo that it may be bored with no great trouble, and therefore ſome hang Jewels and Ear-rings thereon.

It Veſſels. As to *Veſſels*: it hath Veins from the Jugulars.

Arteries from the Carotides.

Little *Nerves*, two from behind, and two from the ſides, ariſing from the ſecond pair termed *Cervicale*.

The Muſcles. *Muſcles* rightly conſpicuous in ſuch as move their Ears, are common or proper. which it was my luck once to ſee, and ſuch *Juſtinian* muſt have had, whoſe Ears could move as *Procopius* deſcribes him. But in moſt people the Ears are unmoveable, both becauſe of the ſmalneſs of the Muſcles, and becauſe there was little need of their motion, becauſe a Man can do that with his Hands which Beaſts do with their Ears, wherewith they drive away flies.

Why few move their Ears?

The uſe of the firſt The *firſt* Muſcle is *common* to the Ear and each Lip; and it is a part of the firſt Muſcle which moves the Cheeks, and the Skin of the Face, and it is termed *Quadratus*, the *ſquare Muſcle*, ſufficiently thin and broad. It is implanted into the Root of the Ear under the Lobe, that it may draw the Ear to one ſide downwards.

The uſe of the ſecond Muſcle. The *ſecond* is *proper* and ſeated more foreward, leaning upon the temporal Muſcle, from the end of the Muſcle of the Forehead (from which it differs by the carriage of the Fibres) ariſing ſomtimes with a round, otherwhiles with a corner'd beginning, and being Tendinous, it is implanted into the upper part of the Ear, where it is narrower, that it may move the Ear upwards and forewards.

The uſe of the third Muſcle. The *third* and hinder more ariſes above the *Proceſſus mammillaris*, from the hind-part of the Head and its Muſcle, with a narrow beginning; afterward growing broader and divided as it were into three parts, it goes hindlongs to the Ear, that it may draw it, ſomwhat backwards and upwards.

The uſe of the fourth, The *fourth* ariſing from the *Proceſſus mammillaris*, being broad, grows narrower by little and little, till at laſt it ends in a Tendon. This Muſcle is rather threefold, becauſe it hath three Inſertions, yet all ſpring confuſed from one place. Some of theſe are ſomtimes wanting, otherwhiles they are all found; ſomtimes there are more, nature variouſly ſporting her ſelf in the Muſcles of the Ear.

The Ear Griſtle. The Ears *Griſtle*, is a ſubſtance tied to the *Os petroſum*, by a ſtrong Ligament ſpringing from the Pericranium.

Certain *Kernels* there are outwardly about the Ears, thick and large, which are termed *Parotides*, though this word do alſo ſignifie the ſwellings of the ſaid Kernels. *The Kernels cal'd* Parotides.

They are not only behind the Ears, as is commonly imagined, but on both ſides and under the Ear, but not above. *Their Situation.*

Theſe *Kernels* by the Ears are called the *Emunctories* of the *Brain*, becauſe they receive the Excrements thereof.

There are alſo many other Kernels in the whole ſpace which is under the lower Jaw, in which many Diſeaſes are bred, and ſwellings called *Scophulæ* in ſome Creatures, as wild Swine. The common people count theſe Kernels a dainty diſh and cal them Sweetbreads. *The ſeat of Kings-Evil ſwellings.*

Their *Uſe* is, to moiſten the parts, and to aſſiſt in the diviſions of the Veſſels.

The Uſe of the External Ear is,

I. For Ornament, and therefore the Engliſh, Dutch and other Nations puniſh Male-factors by cutting of their Ears.

II. To ſaveguard the Brain, that it may not be hurt by the Air ſuddenly ruſhing in.

III. To be the Organ of Hearing, not principal, but aſſiſtant. The true Organ lies within, as doth that of the ſwelling. And as the Noſe being cut off a Man can ſmel though imperfectly; ſo if the Ears be quite cut off cloſe to a Mans Head, he can Hear, but dully, confuſedly, with a murmering noiſe, ſo that Articulate words will ſeem as the noiſe of Water-ſtreams, or the ſcreekings of Graſs-hoppers, as they know who have loſt their Ears. Yea, and the Hearing of that Ear which is not cut off, is dammaged, unleſs the cut Ear be ſtopped. *The External Organ of Hearing.*

The *Uſe* therefore *of the External Ear*, is more readily and rightly to receive ſounds; and to gather them when they are ſcattered in the Air into the Cavity of the Ear, that they may come unto the Drum without violence, being firſt moderated and allayed in the hollow and winding paſſages. Hence, leaſt ſounds which are diven towards the Ears, ſhould ſlip beſide, Beaſts turn their Ears this way and that way to ſounds. Hence alſo the Emperor *Hadrianus*; that he might hear more diſtinctly, would hold the hollow of his Hand before his Ears, which alſo deaf perſons frequently practiſe. Hence ſome Scythians, whoſe earlets ar mortified and rotted of with cold, doth apply a Fiſh-ſhell to their Ears, that the Air being detained in the Cavity thereof, may be more eaſily received, that ſo they may hear the better. Hence, they hear moſt exactly, whoſe Ears ſtick furtheſt out from their Heads, and if our Ears were not too much preſſed down, what by long lying upon them, what by the binding of Nurſes, we ſhould hear better then we do.

The *Internal Ear* hath alſo ſundry parts contained in the *Os petroſum*, and beſides the parts and little cavernes of the Bones, there are: *The Drum*, two *Muſcles*, *the Veſſels* and *inbred Air*. *The Internal Ear.*

In the auditory paſſage cloathed with Skin; through which ſounds are carryed, is found a Cholerick clammy humor, which the Ancients cal'd *Cerumen*, Ear-wax, being purged from the Brain: but Intrinſically it is obliquely placed before this hole or paſſage of Hearing.

There is a certain *Partition*, or little Orbicular Menbrane, compaſſed with a boney circle, which ſome call *Myrinx*, others *Sextum Membraneum* and *Mediaſtinum*, others *Tympanum*, but ſome rightly *mympani Membranula*. For it is ſtretched before the internal Cavity containing the congenit Air, as the Parchment or Velam on a Drum Head. *Caſſerius* conceives that it ariſes from the Pericranium, but *Veſtingius* believe that it is an expanſion of the Periosteum, who hath alſo obſerved it to be double, and alſo frequently cruſted over by thickned Excrements.

Tympanum.

It is *exceeding dry*, that it may ſound the better, for dry bodies are fitteſt for ſound.

It is *Tranſparent* thin and ſubtile, that the ſounds may more eaſily paſs through to the implanted Air: For thoſe that have it thick from their birth, have an incurable Deafneſs, as thoſe alſo who have a thick Coat growing over the ſame without, the Cure whereof is nevertheleſs taught by *Paulus*; and if this happen from the birth, ſuch perſons continue for the moſt part Dumb, becauſe they can neither conceive in their mind nor utter with their Tongue ſuch words as they have never hard.. But if a Snotty matter cleave thereto within, or a thick Humor flow thereto, a thickneſs of Hearing or a Deafneſs incurbale is thereby cauſed. If a thin Humor flow thereto, there ariſe tinklings and noiſes in the Ears.

A cauſe of Deafneſs.

A Cauſe of thickneſs of Hearing.

Finally it is Nervous, of ſo exquiſite a Senſe that, it can neither bear the putting in of a Probe, nor ſharp Humors; yet is it ſtrong ſo as to endure againſt external Injuries; for being hurt or corroded it cauſes thickneſs of Hearing or Deafneſs, as they find by experience, who have it hurt by the noiſe of great Guns or Bells, or in whom it is broken by ſwimming. For the ſafeguard therefore hereof, there are three little Bones added within (of which, the Hammer ſticks faſt to the Drum, and is ſeen through the ſame) and two Muſcles.

The *Uſe* thereof is, to ſhut the paſſage of hearing, and to ſeparate the innate Air from that which is external, and to keep it within. Alſo to ſave it from Duſt, Water, creeping things, &c.

Within the Membrane of the Tympanum, thereis an *Internal Cavity* in the Bone, containing a certain *Air*, which ſome term the inbred, *Congenit* and comp-planted Air, becauſe it is placed in the Ears at the firſt formation, being pure, ſubtile and immoveable: which ſome count the internal Medium of Hearing, others the Organ it ſelf of that Senſe.

The Cavity of the Drum.

There are two *Muſcles* of the inner Ear according to Anatomiſts.

Muſcles of the inner Ear.

They call the firſt the *Internal*, ſeated in the *Os petreum*, with a double Tendon: The one being fixed to the higher proceſs of the Hammer, the other to its Neck.

Its *Uſe* is to draw the Head of the Hammer obliquely inwards, and to carry it inwards from the Anvil, and the proceſs of the Hammer being bowed back, to drive the little Membrane inwards.

The *ſecond is external*, found out by *Caſſerius*, though *Aquapendent* doth likewiſe attribute to himſelf the Invention thereof; it is exceeding ſmal, fleſhy, and conſiſting in the upper Region of the Auditory paſſage, with its Tendon implanted into the Centre of the Membrane, there where the Hammer is inwardly joyned to the ſaid Membrane. So that *Pariſanus* labours in Vain by denying this Membrane in contradiction to *Caſſerius*.

Its *Uſe* is to draw the Membrane with the Hammer outwards.

A certain ſmal Griſtly paſſage is to be obſerved, which goes from the *Concha* of the Ear near the ſides of the *Pterygoidean* proceſs, to the Palate. *Fallopius* ſaies it is a conveighance of Water, *furniſhed with a ſmal Valve*, *Riolanus* in the mean while, an old Maſter of Anatomy, denying that there is any ſuch Valve to be found.

The *Uſe* hereof is, 1. To purge the inbred Air, for this way Excrements paſs from the Ear into the mouth, but, not back again, becauſe there is a Valve to hinder. And this is the Reaſon that Maſticatories are very helpful in Diſeaſes of the Ears.

Why Maſticatories help in Diſeaſes of the Ears?

II. To let in ſound in Deaf and ſtopped Ears.

Varro writes and *Pliny* with *Archelaus*, that Goats draw in Breath at their Ears, which *Ariſtotle* reports of *Alcmeon*. And ſuch as are ſomwhat thick of hearing, do perceive words more diſtinctly when they Gape, and when our Ears are ſtopped, we can hear our own Speech though weakly. Such as have the Venereal Diſeaſe, are hurt not only with cold Air, but with any other uneven noiſe, paſſing through their Mouth into their Ears, as *Tulpius* obſerves, who alſo hath obſerved that two perſons troubled with the *Orthopnæa*, were ſaved from choaking, by voiding their Breath out at their Ears, by means of this paſſage. Thoſe do abuſe this paſſage, who render the ſmoak of Tobacco which they take, through their Ears.

Finally, we meet with the *Nervous Auditories* or Hearing Nerve, which proceeds from the fift pair of the Brain, entring the Ear through the hole of *Os Petroſum*. It touches the *Cochlea* and the *Labyrinth* with a double branch that it may in both places perfect the Hearing. To which a Branch is added to move the Muſcles, proceeding from the fourth pair, and cleft in two.

Chap. X. *Of the Noſe.*

ANother Organ of Senſe follows, *viz.* The *Noſe* the Inſtrument of ſmelling, given to Men and fourfooted Beaſt that bring fourth living Creatures.

Now it is *divided*, as the Ear, into the *External* and *Internal* Noſe.

The *Internal* hath Bones and Nerves, with the Mammillary proceſſes, of which in *their place*.

The Names of the parts of the Noſe.

The *External* is Extrinſecally divided into the upper and lower part.

The *upper part* which is boney and immoveable, is termed the Back of the Noſe, and its Acuminated part, *Spina*. The lower part is Griſtley and moveable, the utmoſt end wherof is termed *Globulus* and *Orbiculus*, by the only feeling whereof *Michael Scotus* pretends to tel whether a Maiden have loſt her Virginity. The lateral or ſide parts are termed *Pterugia alæ*, *Pinnæ*; that is Wings or Pinnacles, that fleſhy part which ſticks out in the middle near the Lips, is called *Columna* the Pillar.

The Noſe is divided within, by a partition Wall, into two Holes or Cavities which they call *Nares* the Noſtrils:

Nostrils: that one hole being stopped, we may draw in and pass out the Air by the other. And when both are stopped, the Mouth supplies the Office of the Nostrils. Now each hole is again *divided* about the middle of the Nose *into two parts*: the one ascends upwards, to the *Os Spongiosum*; the other goes above the Palate into the Throat and upper part of the Mouth. Hence drink sometimes comes out at the Nostrils: and things put into the Nostrils, the Nose being shut, are wont to slip into the Mouth. Hence also the thicker Excrements also of the Brain, while they are carryed downward to the Nostrils, may slide into the Mouth, or be brought thither by Hawking, and so purged out at the Mouth.

It is situate in an high place, *viz.* between the Eyes. 1. For comelyness Sake. 2. Because all smels mount upwards.

The *Magnitude* varies, as also the *Figure*, for some have great Noses, others little Noses, some Hawke-noses and Roman-noses, and others saddle-noses, &c. Touching which *Physiognomists* Discourse.

The parts of the Nose.

Its *Substance* consists of the *Scarf-Skin, Skin, Muscles, Bones, Gristles, Vessels*, and *Tunicles*.

The Skin.

Its *Skin* is thin, and void of fat, that it may not grow too much; under the partion in the Colomme it is thick and Spungy; so that it is like a Gristle and is compast with Hairs termed *Vibrissæ*.

Muscles of the Nose.

There are eight Muscles of the Nose, especially in large Nosed people, but they are smal because the motion of the Nose is little. *Four serve to widen the Nose*, while the *Alæ* or Wings being drawn upwards, they open the holes of the Nostrils. And there are *four more which straiten the Nose*.

The *two first widners* being fleshy, do arise from the Cheek-bone, near the Muscle of the Lips, which they make a third. They are inserted partly into a part of the upper Lip, partly into the lower Wing. *Casserius* found them resembling the leaves of Myrtle.

The FIGURE Explained.

This TABLE represents the Muscles of the Forehead, Eye-lids, Nose, Cheeks, Lips, lower Jaw and Ear-let.

a. *The Pericranium.*
b. *The Periosteum.*
c. *The Hairy Skin or Scalpe.*
d. *The Skull made bare.*
e. *The temporal Muscle.*
f. *The upper Muscle of the Ear.*
g. *The Muscle of the Hind-part of the Head, stretched out to the binder Muscles of the Ears.*
h. *The Muscle of the Fore-head.*
i. *A frontal Appendix spred out upon the Back of the Nose.*
kkk. *The orbicular Muscle of the Eye.*
l. *The triangular Muscle of the Nostrils.*
m. *The common muscle of the Lips, which lefts up.*
n. *The first proper muscle of the upper Lip.*
o. *The second proper Muscle of the upper Lip.*
p. *The trumpeters Muscle.*
q. *The chewing Muscle.*
r. *The common Muscle depressing the Lips.*
s. *The proper Muscle of the lower Lip, caled Mentalis deprimens.*
tt. *The third commmon Orbicular Muscle of the Lips.*
u. *The Circular Muscle of the Nose.*

The IX. TABLE.

xxx. *The part of the Earlet termed* Helix. *page* 151
y. *The opposite Part cal'd* Anthelix.
z. *The part of the Ear-let cal'd* Tragus.
A. *The Antitragus.*
v. *The Lobe or lap of the Earlet.*

The *other two* which are commonly triangular, and like the Greek letter Δ on each side one, with a sharp and fleshy beginning, do grow from the Suture of the Forehead by the *Foramen lachrymale* or Tear-hole, and are implanted into the *Spina* or the *Pinnæ* of the Nose. I have somtimes observed an Appendix thereof to have descended to the upper Lip, *viz.* in such as cannot lift up their Nose without their Lips. *Casserius* against the mind of all Anatomists, draws its original from the *Pinnæ* of the Nose; but they are moveable.

The *two first Straitners*, which are little do arise fleshy;

fleshy, about the Root of the Pinnæ, are carried along transversly, and inserted into the corners of the Alæ. *Casserius* did first of all observe a portion thereof and describe it, which is not alwaies found; for more often the *circular* Sphincter involves the Pinnæ of the Nose orbicularly. The *Use* thereof is a little to shut the Nostrils, depressing the Pinnæ.

The *remaining two* are exceeding firm and membranous, lying hid under the Coat of the Nostrils, in the inner part. They arise from the Extremity of the Nose-bone, and are implanted into the Pinnæ or Wings.

Besides these Muscles of the Nose aforesaid, I have found on the Nose-back of a certain person, a *fleshy Muscle*, thin, stretched right out from the frontal muscle, with a broad Basis, and ending soon after, narrower about the outmost Gristle of the Nose.

The Gristles of the Nose. *Gristles* do make up the Substance of the lower part of the Nose, and are five in number.

The *two uppermost* being broad ones, do stick unto the Bones of the Nose, and the more they descend, the softer they grow, so that the end of the Nose hath a substance, partly gristly and partly ligamental.

The *third* being in the middle of the other two, makes the partition-wall between the two Nostrils.

By these are placed the *other two*, of which the Pinnæ of the Nose are constituted, and they are tied together by membranous Ligaments.

Its Vessels. As to *Vessels*. It hath *Veins* from the Jugulars.

Arteries from the Carotides.

Nerves from the third pare, on each side one, which goes through the holes common to the Nose and eyes, at the greater corner into the Coat of the Nose, and the Muscles, and the Palate.

The Coat of the Nostrils. The *Coat* which cloaths the Nostrils is from the dura Mater, and common to the Mouth, Palate, Tongue, Larynx, Gullet and Stomach; but in the Nostrils it is thinner and of exquisite sense; for being vexed it causes Sneezing: it is bred with many little holes which go into the *Os cribrosum*.

The cause of Sneezing.

Riolanus informs us that within the Cavities of the Nostrils, there are spungy parcels of flesh to be seen, of a reddish colour, wherewith the spungy bones of the Nose are filled, of which being swelled, the Disease in the Nostrils, called *Polypus*, is bred, touching the pulling out and cure whereof, read *Tulpius*.

The use of the Nose. The *Use* of the outer Nose is

1. That through it air may enter into the Brain for the needs of the Animal Spirits.

2. That by it air may enter into the Lungs, for the cooling of the Heart, and to breed vital Spirits.

3. That by the Nostrils Odours may be carried to the Mammillary processes, which lie concealed above the *Os cribrosum*. And therefore they whose Nose is cut off at the Roots, cannot smell at all, or badly.

4. That the Excrements of the Brain may flow down there through, as by a Channel. Which is but a secondary use of the Nose, because *Jo. Walæus*, *Jo. Dom. Sala* my Masters and my self, have known some persons that never voided any Excrements at their Nose.

5. It is also somtimes assistant to the Voice.

6. It adds an Ornament to the Face. It is storied in the Chronicles of *England*, how a company of honest Maidens of that Country, in the time of the Daneish War, did cut off their own Noses, that they might preserve their Maidenheads from the violence of the Daneish Soldiers, by this deformity. This was the punishment of Adulterers in *Ægypt*, which also *Jehovah* threatens to the Inhabitants of *Hierusalem*, by the Prophet *Ezekiel*. In our Historiographer *Saxo*, we read how *Hialto* deformed a Curtezan by cutting off her Nose, when she asked him who should be her next Lover. And therefore because it makes much for the Ornament of the Face, the *Chirurgia Curtorum* was invented, teaching how to supply a Nose in the room of that which is cut off, of which see *Tagliacottus*.

Chap. XI. *Of the Mouth, Cheeks and Lips.*

THe last Organ of Sense remains, viz. the *Tongue* the Organ of Tasting, which before I explain, I must propound the external parts about the Mouth, and the internal parts in the Mouth.

The Names of the outward parts about the Mouth. The external parts about the mouth are sundry. The *upper* part under the Eyes, between the Nose and the Ears, by reason of its usual Redness, and the unusual by reason of blushing, is called *Pudoris sedes* the *Seat of shamefastness*, *Malum* or *Pomum* the Apple, also *Circulus Faciei*, the Circle of the Face.

The *lower* and looser part which may be blown up, as we see in Trumpeters, is termed *Bucca* the Cheek, the upper part of the Lip is called *Mystax*. The Cavity imprinted therein and dividing the same, is called *Philtrum*, from its lovelinesse. Now the Lips are two, the upper and the lower, and the chink between both, is termed *Os* the Mouth. The outer parts of the Lips which hang over, are called *Prolabia*. The lower part under the lower Lip is called *Mentum* the Chin; the fleshy part under the Chin is termed *Buccula*.

Now the Mouth consists of parts, partly boney, as the *upper* and *lower* Jaw with the *teeth*; partly fleshy, as the *Lips*, *Lip-muscles*, *Cheek-muscles*, and *lower* Jaw-*muscles*.

The whole inner capacity of the Mouth is cloathed with a thick *Coat*, which goes also about the Gums and Lips, and is thought to be doubled when it constitutes the Uvula.

The use of the Mouth. The *Uses of the Mouth* are:

1. To receive in Meat and Drink, and to prepare the same, or begin Chylification the beginning, of which is performed in the Mouth.

2. To receive in and let out the Air.

3. To speak and frame the Voice.

4. To give passage to the Excrements of the lungs, the Head and Stomach, by hawking, spitting, and vomiting.

Two pare of Muscles common to the Cheeks and Lips. *Two pare of Muscles* there are, common to the Cheeks and Lips, on each side two Muscles.

The *first* is that same broad and *square* muscle lying under the skin of the neck, which the Ancients did not distinguish from the Skin.

It arises about the Channel-bones, and the hinder-part of the Neck; and with oblique *Fibres* (which a Surgeon must diligently observe, least he cut them freely and athwart, and so make the Cheeks to be pul-

led

ed away to one side) it is implanted into the Chin, the Lips and Root of the Nose, and sometimes of the Ears: which parts also it moves to the part, and this is first cramped in the *Spasmus Cynicus*.

Spasmus Cynicus.

The *second* lies under this, which makes the Cheeks with its Bulk, and therefore is termed *Buccinator* the trumpetting Muscle, which is most conspicuous in Trumpetters.

The Figure of the Muscle Buccinator.

'Tis *round* like a Circle, thin and membranous; interwoven with sundry Fibres, inseparably clothed with the coat of the Mouth.

In the Centre hereof *Casserius* hath observed a certain strong band, breeding from without, and creeping to the Cheek-bone, where it is terminated into a certain small and lean Muscle, directly opposite to the Bucca.

This Muscle *arises* from the upper Cheek-bone, is *inserted* into the lower, at the Roots of the Gums.

Its *Use* is to move the Cheeks and Lips; and it is to the teeth instead of an hand, while it thrusts the meat this way and that way to the teeth, that it may be more exactly chewed.

The Lips.

The *Lips* consist of undigested spungy flesh (*Fallopius* reckons it for the ninth pare of Muscles which move the Lips) whose Skin is so mingled with Muscles, that it seems to be a musculous Skin, or a skinny Muscle.

Trembling of the Lip in such as are ready to cast, how caused?

They are covered with a *Coat* common to the Mouth and Stomach: and thence it is that in such as are ready to vomit, the lower Lip trembles.

The parts of the Lips which touch one another are red, because of the afflux of blood.

Their *Use* is, 1. To shut in the Mouth and Teeth, and to defend the inner parts from cold and external Injuries.

2. For the conveniency of Eating and Drinking.

3. For the Voice and Speech.

4. To cast out the Spittle, and therefore that Servants might not spit nor speak, they were bound with Skins, as *Ammianus Marcellinus* informs us.

5. For Ornament.

There are some *proper Muscles of the Lips* besides the common ones aforesaid, which nevertheless may vary in respect of number. Some reckon fewer, and others more: for some are by some Authors counted simple, which others reckon to be manifold.

The proper Muscles which move the upper Lip, are on each side two. Three there are which move both Lips. The lower Lip is moved only by one proper pare.

Four pare of muscles moving the upper Lip.

The *first pare* proper to the upper lip, is a remarkable pare described by *Fallopius*, which *slipping down* from the corner betwixt the Eyes and Nose, is straight way *sunk* into the Substance of the upper Lip.

The other pare, arising from the upper Jaw-bone, just in the Cavity of the Cheeks under the Socket of the Eye, thin but broad, fleshy, sunk into store of Fat, is carried downwards right on, to the upper Lip, which moves it directly upwards with the first pare. Sometimes also it is obliquely inserted into the confines of both the Lips, wherefore some do make two pare thereof.

Muscles common to both Lips.

The *first pare* common to both Lips, is long, fleshy, broad at the beginning; *arises* outwardly from the Jugal process, and descending obliquely through the Cheeks, it is *terminated* in the space between the two Lips. Sometimes I have seen it from the beginning drawn out as a Rope to the first proper pare. Its *Use* is, to draw both the Lips obliquely upwards towards the Temples.

The *second common pare* of the Lips, from the lower Jaw-bone to the sides of the chin, fleshy, arises with a broad beginning, and sometimes stretched out to the middle of the chin, grows by little and little narrower, till it is obliquely inserted into the same confine of each Lip, but lower, which draws away the Lips obliquely downwards and outwards, in such as grin and gern for anger.

The *third Muscle* common to the two Lips is circular like a Sphincter encompassing and constituting the whole Mouth, spungy, and firmly sticking to the ruddy Skin, it draws the Mouth together, when people simper as Virgins are wont to do.

Muscles of the lower Lip.

The *proper pare* of the *lower Lip* is called *Par Mentale*, the *Chin-pare*; *arising* from the middle of the Chin with a broad beginning, and ascends directly to the middle of the lower Lip, which it moves downwards.

Now all the Muscles of the Lips, are so mixed with the Skin, that the Fibres do cross one another mutually, and therefore the motions of the Lips are very divers.

To cause that exquisite Sense which is in the Lips, Branches of Nerves are sent thither, and Veins and Arteries from the neighbouring places: from whence that same ruddy splendor of the Lips proceeds, a note of Beauty and of Health.

Muscles of the lower Jaw.

The *Muscles of the lower Jaw* (for it is moved) the upper being immoveable) some reckon eight, others ten, called *Masticatorij*, *Manforij*, *Molares*, Chewers, Eaters, Grinders, because they serve for the chewing or grinding of the meat. One only pare depresses the Jaw, because it is apt to go downwards of it self: the other pares fetch it up, which are exceeding strong ones. Hence it is that some can take heavy weights from the ground with their teeth, and so carry them. Hence phrantick and otherwise distracted persons do shut their mouths with so much stubbornness and strength, that they can hardly be opened with great force and iron Instruments. Contrariwise, the stubborneſt person in the World may be compelled without much ado, to shut his or her mouth.

Temporalis.

The *first* Muscle is termed *Crotaphites*, the *temporal* Muscle from its Scituation, because it possesses the Cavity of the Temples.

This is the greatest of them all, firm and strong, yet firmer and stronger in some Beasts, as Lyons, Wolves, Dogs, Swine, &c. which were naturally to bite hard.

The use of the temporal muscle.

For the *End* of the temporal Muscle, is in the beginning of the lower Jaw, which it moves and draws upwards, and so shuts the mouth; and it is terminated in a sharp process, with a tendinous Nerve short and strong.

Now it arises from the Temples with a beginning broad, fleshy, and semicircular, and by little and little grows narrower as it descends.

Why 'tis dangerous to hurt the temporal muscle.

Three *Nerves* are on each side inserted thereinto, two from the third pare, another from the fift pare. And therefore this Muscle being wounded or bruised, there is great danger of Convulsion and

of Death in conclusion; especially if the lower part be hurt which is most Nervous. And because of the distention hereof, *Hypocrates* did pronounce the Luxation of the lower Jaw-bone to be deadly, unless it were put presently in joynt again.

For safeguard sake, Nature hath given it, 1. A *Membrane* thick and hard, and black and blew in color, wherewith it is covered, and shines with a neat color; the Pericraneum, so that the inner part of the Muscle being all fleshy, doth there stick to the bone without the Pericranium. 2. The *Os jugale* over the lower part Tendinous and Nervous. 3. She hath fenced the Tendon with flesh above and beneath.

Manforius primus.

The *second* Muscle is the *Manforius primus, first chewer*, called *Masseter, Molitor*, and *Mandibularis*, or *Lateralis*, seated in the Cheeks.

It *arises* from a double Head: the one fleshy, the other Nervous, from the *Os jugale*, and the first bone of the upper Jaw. It is *implanted* into the lower part of the Jaw-bone (by a Connexion sufficiently broad and strong) which it turns this way and that way, in such as are eating. For the Fibres of the Head do so interfere and cross one another, that they move the Jaw both forwards and backwards and sideways.

Alaris.

The third pair is the *Pterygoides* or *Alare externum*, the outward Wing-muscle, the finding whereof we owe to *Fallopius*; but *Vesalius* accounts it a part of the temporal Muscle. 'Tis seated under the temporal.

It *arises* from the *Os Sphænoideum* and the external *processus Alaris*, with a beginning partly Nervous and partly fleshy. 'Tis *implanted* into the Neck of the lower Jaw-bone, and the inner seat of the Head thereof.

Its *Use* is to move forwards and thrust out.

Manforius alter.

The *fourth* is termed *Manforius alter*, the other Chewer, or *Alaris internus*, being thick and short.

It *arises* Nervous from the Productions of *Os Sphænoideum* called *Alatæ internæ*; and is inserted into the inner and hinder part of the Jaw, with a broad and strong Tendon.

Its *Use* is to draw the Jaw upward and backward, to assist the temporal Muscle.

Graphyoides.

The *fift* is termed *Graphyoides*, because

It *arises* from the Appendix Styloides, Membranous and broad, and soon becoming round and fleshy, tis *inserted* into the Chin. Hence it is seen to have a double belly, and therefore 'tis also termed *Digastricus*, twi-belly. 'Tis fastned to a Ligament least it should go too far back. For,

Its *Use* is to draw the Jaw downwards and so to open the Mouth.

Others do reckon for another pair, part of the *Musculus quadratus*, fixed in the middle of the Chin. Which broadest Muscle, arising from the upper part of the Brest-bone, the Channel bone and the Shoulder tip, and covering the Neck and the whole Face; after *Galen, Sylvius*, and *Theophilus*, *Riolanus* describes in this place. I spoke thereof, in the beginning of the Chapter.

Chap. 12. *Of the Parts contained in the Mouth, viz. the Gums, Palate, Uvula, Fauces, and Throat-bone.*

PArts contained in the Mouth besides the Teeth: are the *Gums, Palate, Uvula, Fauces, Tongue-bone, Tongue, Almonds or Tonsillæ, Larynx, and beginning of the Gullet.* Of the three later I spoke in my second Book, because of the Connexion of Parts. Of the five former, we will treat in this Chapter and of the Tongue in the Chapter following.

Gingiva.

GINGIVA the *Gum*, is an hard flesh compassing the Teeth like a Rampart, and in such as have lost their Teeth, serving in some measure to chew their meat: which being either eaten away, or too much relaxed, or overdryed, the Teeth become loose, or fall out.

Palatum.

PALATUM the *Palate*, is the upper part of the Mouth moderately hollow, like the Roof of an House, whence it is called the Heaven of the Mouth, and is the Basis or Foundation on which the Brain rests, being made of the *Os Sphænoideum.*

'Tis invested with a *thick Coat* arising from the *dura Mater*, which covers the Cheeks and whole mouth on their Insides, and is common to the Gullet and Stomach, and therefore there is also a consent between these parts. Nor can we purge the Head with Masticatories, unless we purge also the Stomach by the Palate.

'Tis furnished with *small Nerves* for Sense.

The Uvula how seated.

The UVULA hangs from the Palate further into the Mouth near the passages of the Nostrils, over the Chink of the Larynx among the Almonds or Kernels so called. Some call it *Gargareon*, from the noise it makes when we *Gargle* any Liquor; 'tis also called *Gurgulio* and *Columna.*

It is a Process made of a Glandulous, Spungy and red *substance*, which *Columbus* doth suppose to be made of the Coat of the Palate Reduplicated in that place. *Riolanus* rather believes that it is flesh, arising from the extremity of the Muscles, which are carried to the Body.

Its Muscles.

It is *roundel* i *long*, thicker *above*, and ends in an acute Figure obtusely. It is suspended and held up by two little Muscles, an Internal and an External pair, either to stir the Uvula Forward and Backward in the time of swallowing, or when it is relaxed with Humors and falls down, to draw it up again.

Riolanus, from *Aretæus*, the *Author of Anatomia Vivorum, Abensina* and *Carpus*, describes two broad Ligaments fastening the Uvula on both sides, like to wings spred abroad, which the Arabians term *Galsamach* of which he is worthy to be consulted.

The falling of the Uvula.

Sometimes by reason of Humors too much flowing in, it hangs two much down, which is called *Casus Uvulæ* the *falling down of the Palate of the Mouth.* Which if it cannot be restored to its place by Medicaments nor manual operation, it is wont to be burnt and cut by Skilful Chirurgeo u.

The FIGURES Explained.

The X. TABLE.

In this TABLE are shewn *Os Hyoides*, *Uvula*, and certain Muscles of the Tongue.

FIG. I.

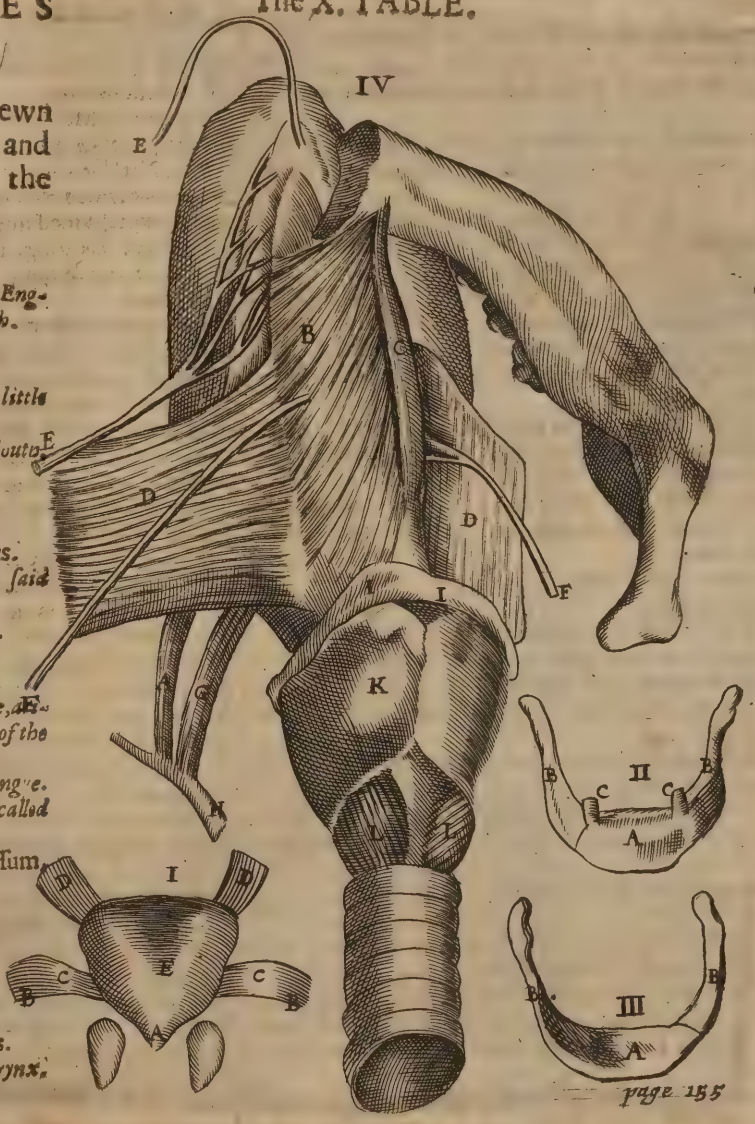
A. *The Gargareon or Uvula, in English the Palate of the Mouth.*
BB. *An outward pair of Muscles.*
CC. *Its tendon.*
DD. *An inner pair of Muscles, a little compressed.*
E. *Part of the Roof of the Mouth at which the Uvula hangs.*

FIG. II. & III.

AA. *The Basis of* Os Hyoides.
BBBB. *The sides or horns of the said Bone.*
CC. *Two Gristly Appendixes.*

FIG. IV.

A. *The first Muscle of the tongue, arising from the external Face of the Styloides.*
B. *The second Muscle of the tongue.*
C. *A Muscle of the third pair called* Genio-glossum.
DD. *The fift pair* Cerato-glossum, *scituate without.*
EE. *The tasting Nerves.*
FF. *The tongue moving Nerves.*
G. *A muscle of* Os Hyoides.
H. *The Processus Styl formis.*
II. *The* Os Hyoidis.
K. *The* Cartilago Scutiformis.
LL. *Two muscles proper to the Larynx.*



Its *Use* is to moderate, the coldness of the Air, that it may not suddenly rush into the Lungs: and therefore those that have lost the Palate of their Mouths dye of a Consumption.

Some think it helps to modulate the Voice, *Vulgar Error.* and therefore they call it *Plectrum vocis*, the striking quil of the Voice. But though it be wounded or quite cut off, yet is not the voice hurt, unless some neighbouring parts, which assist the voice are also damaged: for then by the roughness of those parts, caused by those Catarrhes, which have eaten the Uvula, the Voice becomes Hoarse.

A second Use is, to hinder drink from passing out of the Mouth into the Nostrils. And therefore *Salmuth* tels of the Son of a Man called *John*, who being born without any Uvula or Almonds, voided the Milk which he suckt, out of his Nose, and did not live long.

By FAUCES sometimes we understand the whole wideness of the Mouth: but more strictly it is meant of the hinder and lower part, which cannot be seen, but when the Mouth is wide open and the Tongue held down, the Greeks term it *Pharynx*, howbeit that word in *Hypocrates* doth oftentimes signifie the Diseases of this part, as Inflammation, &c. *Galen* calls it *Isthmus* because of the narrowness of the place.

Names of the Os hyoides.

In the *Fauces* is that Bone which from the shape of the Greek letter υ is called *Hyoides*, *Hypsiloides*, also from resemblance to the letter Λ *Lambdoides*, that is the Upsilon or Lambda-shaped Bone. 'Tis also called *Os gutturis*, the Throat-bone, and *Os linguæ*, the Tongue-bone, of which I must treat in this place, and not in the History of the Bones, because it is not fastned to the other parts of the Skeleton.

Now the Bone is the Basis and Foundation of the Tongue, upon which it is placed and moved: and it is set before the Larynx.

Its Construction.

It consists of sundry little bones, three at least, sometimes of five, seven, nine.

The middle Bone is the greatest, bunching without, hollow within, under which sticks the Epiglottis;

Epiglottis; it hath processes termed *Cornua, horns* two in Number, consisting of Bones more or fewer, greater or lesser.

Four *Gristles* are added, two are somewhat great, long and round, in the Belly of *Os hyoides*, two also besides the Horns, which in some persons become bony.

Its processes are fastened to the Ligaments and ends of the *Styloides*, also with the Cartilago guttalis.

Its Muscles. This *Bone is moved*, but not except the Tongue be moved; and therefore it hath four pair of Muscles common to the Tongue, nor can the Muscles of the Tongue be shewed till they are removed.

The *first pair* lies concealed in the fore-part, under the Skin, resting upon the Weasand and the Cartilago Scutalis.

It *arises* with a broad and fleshy beginning, from the higher and inner Region of the Breast-bone; and therefore this pair is called *Sterno-hyoides*. Its *End* is fleshy, in the Basis of *Os hyoides*. And in the middle according to their length, these Muscles are divided with a line.

Their *Use* is to draw right down.

The *second* being under the Chin and the fist pair of the lower Jaw; is large, short and all fleshy.

It *arises* from the inner part of the lower Jaw, with a various carriage of Fibres: it is *ended* in the middle seat of the *Hyoides*. Some call it *Genio-hyoides*.

Its *Use* is to draw right upwards and a little forwards.

The *third* is lean and round, seated under the Chin, arising from the Root of the Appendix of Styloides; it *ends* into the horns of the Hyoides. Somtimes they are bored through the middle, for the Muscle which opens the Jaw.

The *Use* is, to move sidewayes, and a little obliquely upwards. 'Tis called *Stylo-cerato-hyoides*.

The *fourth* being lean and long, lies concealed under that Muscle of the Scapula which they count the fourth, moving downwards and obliquely sideways.

It *arises* from the upper side of the Scapula, near the processus Coracoides, and therefore 'tis called *Coraco-hyoides*: it is carryed upwards obliquely to the sides of the *Os hyoides*, under that Muscle of the Head which is counted the seventh. And this pair is long, hath two Bellies, and is extenuated in the middle like a Tendon, like that which draws down the lower Jaw.

Some add to these a *fist pair*, which is indeed proper to the Tongue, *Riolanus* indeed the *Mylo-glossum* and therefore he terms it *Mylo-hyoideum*; but *Vesslingus* the *Genio-glossum*, and therefore he calls it the *Genio-hyoides internum*: which arising inwardly from the Chin under the *Par Genio-hyoideum*, is inserted into the Basis of the *Hyoides*, which it draws straight upwards.

The Use of Os hyoides. The *Use* of this *Os hyoides*, is

I. To be the Basis of the tongue, and yet but obscurely moveable: least as *Walæus* conceives, it should perpetually hang in the Throat, and hinder the swallowing of Meat; but it moves forward in swallowing, and so makes the Orifice of the Gullet more wide.

II. That from it many Muscles might arise of the tongue and Larynx.

Chap. 13. *Of the Tongue.*

The tongue. THE TONGUE called *Lingua a lingendo* from licking,

Its Scituation. Is *placed* in Mankind, in the Mouth under the Palate thereof:

Number. Is in *Number* one, in Sea-Calfes two, in Serpents divided into three parts, in Lizards and Snakes divided into two parts.

Figure. In Man 'tis long, broad and thick, and thicker at the Root, thinner and sharper at the End.

Magnitude. Its *size* is moderate answerable to the mouth, which if it be too great, so that it cannot move readily, it makes a man Lispe and Stutter; and if it be oversoft and moist as in young Children, they cannot speak plainly. *Galen, Camerarius, Zacutus Lusitanus* and *M. Donatus*, have observed the tongue grown to so monstrous a greatness, that it could not be contained within the mouth.

Its Connexion. As to the *Connexion*, in fishes the whole tongue cleaves to their mouth; in mankind, it is in its hinder part fastned to the Larynx, and the *Os hyoides*, also to the Fauces and Tonsillæ. Beneath in the middle of its body 'tis fastned with a strong membranous Ligament for strength and stabilities sake, also for the insertion of its proper muscles, whose extremity is termed *Frænulum*; nor can any other string be found different from this. This in many new born Children, doth so tie the whole tongue, that it is wont to be torn by the Nail of the Midwife (which is

A Pernitious Practice of midwives. nevertheless a Pernitious course and not to be allowed) or the small Knife of a Chirurgeon, that it may not hinder the Childs sucking or future speaking, and that it may freely turn and move it self. Howbeit for want of skill, they cut it in all Infants indifferently, whereas not one of a thousand, when it is let alone, doth stammer.

Its Coat. 'Tis cloathed with a Coat (hard in such as use to swallow very hot Liquors) ordinarily thin, soft, and porous, that tasts may easily peirce into the tongues fleshy

Substance. *Substance*, which is a peculiar kind of flesh, such as is not in the Body besides (and it is the Organ of tast, not the Coat, as *Galen* would have it, nor the Nervus Gustatorius, as some from *Columbus*) soft, loose, rare and spungy, to drink in the tasts brought to it with some humidity. In Fishes and some other Animals 'tis bony. It is rather of a kernelly then a Musculous substance, especially about the Basis thereof.

Whether the tongue be a muscle. For the tongue is no Muscle, seeing it hath no Fibres, nor moves any other part, but is moved by its Muscles. Others add this Reason, because then motion would be made towards the end of a Muscle, and the tail of a Muscle should be moveable, the head immoveable. But this Reason is false. For the beginning of the tongue is near the Larynx, and arises as it were from the *Os Hyoides*.

Its Vessels. As to *Vessels*. Two remarkable Veins are to be seen under the tongue, which are wont to be opened in Quinzies and Diseases of the Fauces, termed *Raninæ* from their color, arising from the external Jugulars, these

Two

Two pretty big *Arteries* do accompany, from the *Carotides*.

Nerves are inserted into the Tongue, both those of motion, and those of Sense: a thicker pair creeping through the inner parts, from the seventh conjugation, which being obstructed or not reaching to the Tongue, the tast is lost according to the observation of *Columbus*. A *thinner* pair runs through the outer parts of the Tongues Coat, arising from the fourth conjugation, or as some say, from the third.

The line of the tongue. The Tongue is distinguished in the middle of its surface, into the right and left part, by a certain *white line*, which *Hippocrates* terms *Mediana*.

Its muscles The *muscles proper* to the *Tongue*, ending in its substance, are by some Anatomists reckoned to be six, by others nine, by some ten, by others eleven, which move the Tongue, upwards and downwards; forewards and backwards; to the right hand and to the left.

The *first pair*, which in Oxen is double fleshy and thick, *arises* from the out side of the Appendix *Styloides*, being Maigre in Mankind: it *ends* with transverse Fibres, into both sides of the Tongue, about the middle thereof.

Its *Use* is to move the Tongue inwards. But by reason of the Fibres interwoven, they lift the Tongue upwards if they act both together; but upwards only to one side, if only one of them act. This pair is called *Stylogloſſum*.

The *second pair* is called *Myogloſſum, arising* from the sides of the lower jaw, at the Roots of the grinding Teeth. Tis inserted under the Basis of the tongue, into the tongues Ligament. *Riolanus* will have it belong to the *Os hyoides*, because it touches not the tongue. But it suffices to move the tongue, if it be affixed to the Ligament thereof.

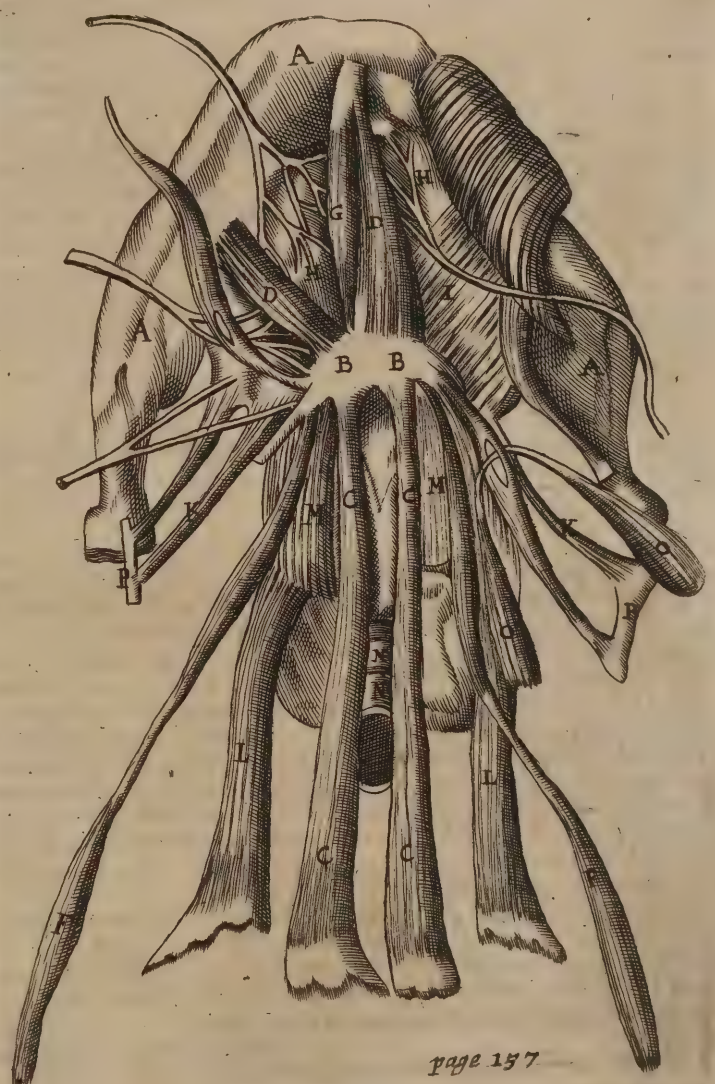
Its *Use*; when one acts, the tongue is moved obliquely upwards; when both act, it moves with its point right to the Palate and upper teeth.

The FIGURE Explained.

This TABLE expresses the Muscles of *Os Hyoides* and of the Tongue.

AAA. *The Body of the lower Jaw.*
BB. *The Body of* Os Hyoides.
CC. *The first pair of Muscles called* Sternohyoides.
D. *One Muscle of the second pair in its situation, the other removed therefrom.*
EE. *The third pair bored in the middle.*
FF. *The fourth pair Coraco-hyoides.*
G. *A Muscle of the fourth pair of the Muscles of the tongue.*
HH. *The Parenchyma of the tongue into which the Nerves are inserted.*
I. *A Muscle of the fift pair of tongue Muscles.*
KK. *A Muscle of the first pair of tongue Muscles.*
LL. *The common muscles of the Larynx, cal'd* Sternothyroidei.
MM. *Other common muscles of the Larynx,* Hyothyroidei.
NN. *The Gristles of the Aspera Arteria.*
OO. *A muscle of the lower Jaw cal'd* Digastricus, Twibelly.
PP. *Portions of the processus* Styloides.

The XI. TABLE.



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The *third pair* arises inwardly at the middle of the Chin, whence tis called *Geneo-gloſſum*; it *ends*, well-near into the middle of the tongue inwardly. *Veslingius* will have it fastned into the Basis of the *Os hyoides*, and therefore he reckons it amongst the Muscles thereof. And by reason of the diversity of its Fibres, it seems to perform contrary actions: for the greatest part of the Fibres, which is towards the Root of the tongue, being drawn towards the Original, the tongue is thrust without the Lips; but the smallest part of the Fibres acting, tis drawn inwards. This pair hath inscriptions as if it were many Muscles.

The *fourth pair arises* fleshy out of the upper and middle Region of the *Os hyoides*, and is terminated in the middle, after it is drawn out according to the length of the tongue. It is sometimes obscurely divided, as if it were many Muscles.

Its *Use* is, to draw the tongue right in, and so to depress the same. And it is called *Basioglossum*, or *Hypsilogloſſum*.

The *fifth pair* is called *Cerato-glossum*, because it *arises* from the upper horns of the *Hyoides*, and is obliquely inserted into the sides of the tongue, near the Root thereof.

Its *arises* sometimes from the lower horns, *viz.* when the higher are wanting, especially in Women. And this pair is double in Oxen.

Its *Use* is, to move the tongue directly downwards towards the inner parts, when both act; but if only one be contracted, it moves it to the right or left side.

By others an *eleventh* Muscle is added, which yet is no Muscle, because it consists not of fleshy Fibres; but it is a parcel of flesh, consisting of very many Kernels and fat, situate at the Root of the tongue, and appearing when the foresaid Muscles are taken away.

Its *Use* is, that the tongue may be moistened by this plenty of Kernels.

The use of the Tongue.

The *Use* of the Tongue is:

I. To be the Instrument of Taſt.

II. Of Speech.

III. To further the chewing of Meat, by turning it this way and that way.

IV. To lick with.

By all which it appears, that the tongue is not necessary to the very being of life, but to the well being: for the part thereof may be cut off without danger of life or health, *Zacutus*, *Walæus* and others after *Galen*, have found by experience. *Abenzoar*, *Joubertus*, *Foreſtus*, have observed that Stones have bred under the tongue, hindring Speech, till they were cut out; and I remember that long since such stones were taken out at *Padua*.

THE

THE FOURTH BOOK OF THE LIMBS.

The Limbs what?

BY Limbs we understand those Members which grow as it were out from the Trunk of the Body, viz. the ARMES above, the LEGS beneath. In which are chiefly considered the Muscles, Veins, Arteries, Nerves and Bones. Of the four last I shall treat, in the four following Manuals: but of the *Muscles* of the *Limbs* in this Book, as also of the neighboring Parts, viz. the Head, Neck, Chest, Back, &c. their Muscles; not because they appertain to the Limbs, but because in the Order of Dissection, an Anatomist cannot shew them before the Muscles of the Limbs.

Why the muscles also of the Head, Neck, Back &c. are handled in this Book?

Chap. I.

Of the Arm and Hand in General with the Nails.

The use of the Hand.

ARistotle calls the Arm with its Hand, *Organon Organón*, the Instrument of Instruments, wherewith Man otherwise naked and unarmed is guifted, that he may not be inferior to the Brute-beasts and conquered by them; but may overcome them, making for himself Weapons, and other necessary Instruments. Man therefore hath received Reason and Hands, which Beasts have not; and the Hand is his Servant and Instrument.

Manus what?

Now the old Writers *Hippocrates* and *Galen* by HAND did understand that Part of the Body, from the top of the Shoulder to the ends of the Fingers, and this is termed *Summa Manus*.

And it is *divided* into the Arm and Hand strictly so called, or the *extrema manus*.

And the *Arm* is divided again, into the Shoulder and Cubit, the *Shoulder* is the part of the Arm from the Shoulder-tip to the bending of the Elbow.

The *Cubit* is that part from the bending of the Elbow unto the Wrist.

The *Manus extrema* or *Hand properly so called, is divided into the Brachiale* or *Wrist*, which is the part between the Elbow and Palm; into the Postbrachiale or Metacarpum, *after-wrist*, which is the part between the Wrist and beginning of the Fingers, and into the Fingers. The Postbrachial part internal is called the *Palm* of the Hand, the external part is called the *Back* of the Hand.

Why many Fingers on the Hand?

There are many *Fingers*, that the action of the Hand might be the better performed, which is laying hold: also that we might be able to take up the smallest matters, which we do by two fingers, and other things of many-shaped Figures: and because all things could not be comprehended with one hand, two were made that meeting together, the one might help the other.

Why the right Hand is more active then the left?

The *right* Hand is more active commonly and more ready for motion, not for those causes which others childishly cite, but 1. Because in a mans right side is the *Vena sine pari* so called, which peradventure is double in such as can use both hands alike. 2. Because the bones are more heavy in the Shoulder, Shoulder-blade and whol arm, then on the other side, as some men know for certain; which may proceed from an impression of more plentiful Heat in the Mothers Womb, the right part whereof is hotter then the other. Hence *Aristotle* teaches, that naturally the right hand excels the left; and in another place, he tells us the first endeavor of motion is on the right side; so that when a man is about to walk, first moves his right Leg; a Bird about to flie, moves first its right wing. 3. Because the trunk of the Subclavian Artery is greater on the right side then the left, as they know that have diligently considered the matter in opposition to *Riolanus*, though the difference is not, neither needed to be very great. *Plato* conceives that all men are naturally ambidexters, viz. that they can use both hands alike, and that it is mens unskilfulness and ignorance that makes them right handed only or left handed. But *Aristotle* is of Opinion, that from our first Formation, the right sides of our Bodies, are alwaies in a manner hotter and stronger then the left, unless any man by much custom, and much exercise, do draw much Heat and Spirit to his left Hand that he may become Ambidexter, and able to use it as his right.

The number of the Fingers.

Now the *Fingers* for perfection of Action are made five in number, differing in length and thickness. Tis besides nature, if either the Fingers be quite wanting, which I have seen at *Malta* and at *Florence*; or if in place of true Fingers there appear only certain soft marks

marks as big as Peason, which I lately observed here at *Hafnia*.

The *first* is cal'd *Pollex* a Pollendo because of its strength, and it alone is opposed to the whole four, when any thing is to be taken up, and therefore it is thick.

The *second* is cal'd *Index* and *Demonstrator*, the shewer, or pointer: because therewith we point at any thing.

The *third* is the longest and middlemost, cal'd *Impudicus* the *shameless*, because Physitians use it in filthy and stinking places; not is it wont to be adorned with Rings.

The *fourth* is termed *Medicus*, also *Annularis*, the *Ring-finger*, because it is adorned with a Gold Ring before any of the rest, by reason of a common but false opinion Repugnant to Anatomy, *viz.* that a Vein should come from the Heart to this Finger above all the rest; now the Heart is comforted with Gold.

The *fift* cal'd *Auricularis* the Ear-finger, because fittest to pick the Ears, is smallest, *and by us cal'd the little Finger.*

Laying hold.

How the Hand is compounded?

The Cause therefore of *laying hold*, which is the action of the Hand, or as others speak less accurately, its chiefest use, is the apt composition of the whole Hand. Yet the chief Organ of this motion is a Muscle: the strength is in the Bones, which are three in every finger, the lower of which as the sustainer is alwaies greater then that which is above it and stronger, and in the Joynts they are furnished on each side with a Gristle, on which an Oyly moisture is poured out for Hummectations sake, and to Facilitate the motion.

A *secondary* use of the Arms and Hands as *Kyperus* learnedly Discourses, is the better to help our going by their weight and ballancing; Yea and to speed our going; and therefore dancers on the Ropes, whose Foot is broader then that which they tread on, do bear themselves up with long Poles, and when they dance a pace, they ballance themselves with their Hands, which they move this way and that way.

Of the Nails.

The *Nails* are placed externally on the tops of the Fingers, as also of the Toes: whose upmost part being white, is called the Root of the Nailes, the white half Moon, and the little Skin which grows to the Root.

Their *matter* is not Alimentary Humors; as *Æmilius*, *Parisanus* and *Plempius* would have it, and others, but thick Excrements, not which ascend from the Heart, as *Rosa Anglicana* conceives; or from the Arteries, but from the Bones and Gristles, as the great *Hippocrates* doth affirm.

The *Efficient* is that heat which the Soul directs to this rather then any other part of the Body. But the Nailes are not made by the Soul, as *Parisanus* and *Plempius* contend, because in Cacochymick and Phlegmatick persons they grow more abundantly, in such as have been twenty five years dead, according to the observation of *Pareus*. Nor are we moved when they say that there is a great variety of colours in horns and shels of Fishes, for they no more prove the action of the Soul in such things, then in party coloured and speckled Marble.

Their *End* and *Use* is,

I. To fence the ends of the Fingers and Toes which are exceeding soft, and to saveguard them by their hardness, so that they may more easily take up any thing. So in the Feet, that they may be able to resist the hardness of the Ground and stand firm. And therefore it was ill said by him of old, that the Gods had erred in their placeing the Nails.

II. For ornament: and therefore we cover our Fingers when the Nails are impaired.

III. To rub, scratch and defend, which is a secondary use.

IV. To free the Body from superfluous Humors and steams Fuliginous.

V. To afford Physiognomists and Physitians tokens of Life and Health, which may be seen in divers authors. And *Achmetes* ch. 74. 75. interprets dreams concerning them, according to the Tradition of the Indians, Persians and Ægyptians.

Their *form* we gather from the Accidents.

Their *Figure* is somwhat convex, that they may apply themselves to the Fingers.

They have a substance indifferently hard that they may resist, but yet flexible, that they may yeild a little and not break.

Colour of the Nails and signs from thence.

They are *Transparent* and therefore variously coloured: for according to the flesh beneath them, they are red, blewish, &c. And therefore Physitians are wont to observe the Colour of the Nails; for the Nails, for examples sake, grow pale when the heat of the Heart is deficient; in such as are at deaths door they are livid and brown. Those same white spots which in yong people sometimes appear in their Nails, spring from a vigorous heat, which drives hidden Excrements to the Nails, and separates them from others of a different Nature.

Whence the sense of the nails proceeds

They are *knit* about the Root with a Ligament, and Skin grows about them without; and flesh grows under them, or rather the tendons of Muscles, there dilated: there is therefore in that place an exquisite sense, and great pain when they are hurt.

And so much may suffice to have spoken of the Nails, breifly, and by way of Compendium.

Chap. II. *Of the Muscles of the* Humerus, *or of the* Brachium, *peculiarly so called.*

THe common containing Parts being removed, *viz.* the Scarf-skin, the Skin, the Fat, the *Membrana carnosa*, &c. the Muscles shew themselves, by which the motion is made, of which I am to treat in this whole Book; in a convenient place, though *Hofman* think otherwise, especially because the Doctrin of the Muscles is useful and necessary, by reason of Issues, Wounds, &c. And in the other parts they could not be treated off.

Now touching the *action* of the Muscles of the Arm in general, it is to be noted, that the inner Muscles do mostly serve to bend, and the outer to extend. And in the whole Arm the internal Muscles are more and stronger then the external, because bending is more worthy then the extension.

The Muscles of the Humerus how many?

The *Humerus* is variously moved, and therefore it hath sundry Muscles, partly lying upon the Chest, and partly growing to the *Scapulæ* or Shoulder-blades, &c. Some reckon them seven, others

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thers eight and *Casserius* nine. For the Arm is said to be lift up by two Muscles, *Deltoides* and *Supra-spinatus*; and downwards by two, the *Anconæus* and *Rotundus major*: forewards by one alone, *viz.* the *Pectoralis*; backwards by three, the *Infra-spinatus* and *Sub-scapularis*, and the *Transversus brevior*. But they conceive the circular motion thereof is caused by all of them acting one after another: but others will have the Arm to be wheeled about by the *Infra-spinatus*, *Supra-spinatus*, and *Sub-scapularis*. But I shall in recounting them follow the order of Dissection.

The *first* is termed *Pectoralis*, because it takes up the Breast or forepart of the Chest being great and fleshy; which *Galen* conceived might be divided into three or four.

It *arises* from wellnigh the whole Brest-bone, and the Gristles thereto annexed; where it is a little tendinous in part of the *Clavicula*, and the fift, sixt and seventh true Ribs. 'Tis implanted with a short, broad Nervous and strong tendon, into the *Os Humeri*, between the Deltoides and the Biceps.

Its *Use* is, to move the Arm to the Brest, and as the Fibres are contracted more to the upper or lower part or right forward, so doth the Arm incline this way or that way. This is the Muscle which suffers in that torment which the Italians call *Tratta de corda*, the Strappado. For it is very much haled and drawn a sunder, when the Arms are pulled forcibly backwards.

The *second* is called *Deltoides*, from its likeness to the Greek letter Δ also *Triangularis Humeralis*, which is fleshy and so abides, and is spread upon the Head of the Shoulder.

It *arises* from the middle of the *Clavicula*, looking towards the *Scapula*, and from the top of the *Humerus*, with a fleshy end indeed, but yet a strong tendon lies concealed therein.

Its *Use* is to lift up the Arm. In the middle hereof the Ancients were wont to make Fontanels or Issues; but others in the external part of the said Muscles: but an Issue is better made in the space between the Deltoides and the Biceps, as I shew in *my Treatise of Issues*, because 1. There is the Cephalick or Head Vein. 2. It is between two Muscles. 3. It may be very well seen and dressed by the Patient. Now the place is exactly found below the Shoulder joynt, four or five Fingers bredth, where when you bend the Arm you may feel the space between the two Muscles, and the Arm being lift up, it is Circumscribed in fat persons with a small Cavity, as *Claudinus*, *Solenander* and others observe. *Ferrara* measures four Fingers bredth from the Elbow upwards. See also *Glandorpius*.

The place of an Issue in the Arm.

The FIGURE Explained.

This TABLE represents all the Muscles of the Body described by the Authour, which are to be seen before.

AA. *The Muscles of the Neck, called* Musculi longi.
B. *The Muscles Scalenus.*
C. *The Muscle Mastoides which bends the Head.*
dd. *The Vertebra's of the Neck.*
E. *The Levator Scapulæ, lifter of the Shoulder.*
FF. *The Claviculæ or Chanel bones.*
G. *The Breast-bone, call'd* Sternum.
H. *The Acromon or Shoulder-tip.*
ii. *The Musculus Subclavius.*
K. *The Pectoral Muscle.*
L. *The Muscles Deltoides.*
MM. *The Muscle Biceps.*
N. *The Musculus perforatus, or bored Muscle.*
O. *The Serratus minor, or Smaller-saw-muscle.*
PP. *The greater Saw-muscle, or Serratus major.*
qqqq. *The Intercostal or Rib between Muscles.*
RRRR. *The branchiæus on each Arm, conspicuous from each part of the Biceps.*
SS. *The first Arm extender, or the Longus.*
TT. *The Musculus Radij pronator rotundus.*
V. *Radij Pronator Quadratus.*
W. *Supinator Radij primus.*
X. *Carpi flexor primus or externus.*
Y. *Musculus palmaris.*
Z. *Carpi flexor alter, or the internus.*
α. *The Os Radij.*
β. *The Os Cubiti.*
δ. *The Ligament which fastens the Cubitus to the Radius.*
Γ. *The Digitorum flexor sublimus or Perforatus.*
Θ. *The Profundus or Perforans, under the former.*
εεε. *The Musculi Lumbricales.*
ζ. *The Flexor pollicis or Thumb-bender.*
κλ. *The Muscles which draw the Thumb towards the Hand.*

The following Characters serve to point out those Muscles, which run out from the Region of the Loyns to the End of the Feet, in the forepart of the Body.

A. *The Muscle Psoas or Lumbaris.*
B. *The Muscle Iliacus.*
C. *The Obturator internus.*
DDDD. *The Musculus Triceps, or Tripple-headed Muscle.*
EE. *The Musculus Lividus.*
FF. *The Rectus in its situation, but on the right Leg hanging by its End.*
GG. *The Vastus internus.*
H. *The Vastus externus, which on the right Leg hangs separated.*
II. *The Musculus membranosus, or the Fascia lata.*
KK. *The Musculus Crureus.*
LL. *The Musculus longus, Fascialis or Sartorius.*
MM. *The Musculus gracilis.*
NN. *The Musculus Tibiæus anticus.*
O. *The Musculus peroneus Biceps.*
PP. *The Muscle which extends the four Toes of the Foot.*
Q. *The Muscle which extends the great Toe.*
R. *The Musculus Gastrocnemius.*
rrrr. *The Musculi Interossei.*
S. *The transverse Ligament of the Foot.*
T. *The Tibia.*
V. *The Fibula.*
X. *The Patella.*

The third is *broadeſt of all*, and with its fellow covers almoſt the whole Back. 'Tis called *Ani Scalptor, Clatibreech*, becauſe it draws the Arm backwards and downwards.

It ariſes with a membranous and very broad beginning, from the points of the Vertebra's of the Back bone, from the *Os ſacrum* and *Ilium*, as far as to the ſix Vertebra of the Cheſt. It is inſerted between the Pectoral and the round Muſcle, with a ſtrong, ſhort and broad Tendon. Its *ſhape* is triangular.

Fallopius out of *Galen* againſt *Veſalius*, doth teach that this Muſcle is furniſhed with a new, but very ſmal beginning, while from the lower Corner of the Shoulder-blades, it receives very many fleſhy Fibres. This Muſcle becauſe it hath a large beginning, and therefore divers Fibres; according as they are variouſly contracted, ſo the Shoulder is either drawn more upwards or depreſſed more downwards. And becauſe it alſo paſſes through the lower corner of the Shoulder blade therefore it lightly draws the ſame alſo away with the Shoulder.

The *fourth* is called *Rotundus major*, and it is obliquely ſeated behind, under the Axilla, being fleſhy, thick, and rounder then the reſt.

It *ariſes* fleſhy from the Rib of the lower Scapula, and aſcending a little with its tendon, ſhort, broad, and ſtrong, it is implanted with the Pectoral, into the upper and lower part of the *Humerus*.

Its *Uſe* is, to draw the Arm downwards and backwards, and to work contrary to the Deltoides.

The firſt is ſhort and round, quite fleſhy, which ariſes with a ſharp beginning out of the loweſt corner of the Scapula; after it grows thicker and thicker to the middle of its belly, and thence growing ſmaller by little and little, it *terminates* with an acute end into that Ligament, wherewith the Head of the Shoulder is involved.

It hath an oblique *Scituation*, and ſome call it *Tranſverſus muſculus brevior*, others *Rotundus minor*. And it is the eighth in *Fallopius* his account: which Muſcle others ſuppoſe to be a certain portion of the fourth.

The *ſixt* is called *Infra-ſpinatus*, alſo *Superſcapularis inferior*, becauſe it covers the whole external bunching part of the Scapula, whoſe form alſo it bears; but becoming more narrow, it is with a broad and ſhort Ligament inſerted into the Shoulder.

Its Uſe. It is thought to wheel the Arm backwards and outwards.

The *ſeventh* is the *Supraſpinatus*, alſo *Superſcapularis ſuperior*, alſo *Rotundus minor*; it is fleſhy and ſomewhat longiſh, over the Armpit; it fills the Cavity between the upper Rib of the ſcapula, and the Spina thereof, out of which it *grows*.

Now it is *inſerted* with a broad and ſtrong tendon, into the Neck of the Humerus, at the Ligament of the joynt, being carryed above the firſt joynt.

The *Uſe* of this is thought to be the ſame with that of the former. Others conceive it moves upwards with the Deltois.

The eighth is termed *Subſcapularis* or *Immerſus*; being very fleſhy, it quarters betwixt the Scapula and the Ribs, and takes up the inner part of the Scapula; but it is inſerted with a broad tendon, internally, into the ſecond Ligament of the Humerus.

Its *Uſe* is to bring about the Arm inwards.

The *ninth* Muſcle was firſt obſerved by *Arantius* and *Placentinus*, being in the former part of the Arm and called *Perforatus*.

It ariſes from the *Coracoides Proceſſus* of the *Scapula* (and is therefore by *Riolanus* called *Coracoideus*, or *Coracobrachiæus*) it is *inſerted* into the inner part of the Shoulder about the middle, by the tendon of the Deltoides. It hath a beginning nervous and ſhort, a long round Belly ſufficiently corpulent, and a ſtrong tendon. Its Belly hath an hole bored in it, and gives paſſage to the Nerves, which are diſtributed to the Muſcles of the Cubit. This Muſcle others have only termed a muſculous Portion of the Biceps.

'Tis *uſeful* to draw the Arm to the Proceſs of the Scapula; or draw it forward upon the Breaſt.

Chap. 3. *Of the Muſcles of the Scapula or Shoulder-blade.*

BEcauſe the *Scapula* is moved forward and backward; upward, and downward; therefore it hath received *four Muſcles*. To which nevertheleſs others add two more, viz. the *Serratus major* and the *Digaſtricus*, but they do not well. For the later is proper to the *Os hyoides*, the former to the Cheſt.

The Error of other Anatomiſts.

I. The firſt is called SERRATUS MINOR, and it is ſpred under the *Muſculus pectoralis*.

It ariſes from the four upper Ribs, excepting the firſt and aſcending obliquely upwards, with an end partly fleſhy, and partly tendinous, it is *inſerted* into the Scapula by the *Proceſſus ancoriformis*.

Its *Uſe* is to draw forward into the Breaſt.

II. The ſecond is by *Galen* called *Trapezius*, others term it *Cucullaris*, becauſe it reſembles a Friars Cowl. But that this *Muſcle* was given our firſt Parents, as the Badge of a religious life, as *Riolanus* conjectures, I do not believe, becauſe others are religious that wear no Cowles, and many are irreligious that wear them, whether you look at their Profeſſion or Manners. However this Name was given this Muſcle by Chriſtian Phyſitians, becauſe of its likeneſs to a Monks Cowl.

It *ariſes* fleſhy and thin from the hinder-part of the Head. From whence it deſcends to the eighth Vertebra of the Cheſt, and from thence as alſo from the hinder part of the Head growing ſmall by little and little, it is inſerted into the Back-bone, the Scapula, the top of the Shoulder and the Clavicula.

But becauſe of its various Original and various Fibres,

It variouſly moves the Scapula, upwards, obliquely, by reaſon of Fibres obliquely deſcending from the hind-part of the head to the Omoplata, which *Riolanus* denies in vain; downwards, by reaſon of the carriage of fibres, aſcending from the eighth Vertebra of the Back; and right out to the Back, by reaſon of right fibres in the middle of the Muſcle, ſtretched out to the Scapula.

III. The third is the *Rhomboides* from its figure like a Diamond, ſcituate under the Cucullaris, thin and broad.

It ariſes from the three lower Vertebra's of the Neck and the three upper Vertebra's of the Cheſt, and with the ſame latitude is *inſerted* into the Baſis of the Scapula.

Its *Uſe* is to draw back a little obliquely upwards.

IV. Is the *Levator*, which others call the Muſcle of Patience; becauſe thoſe whoſe Affairs go croſs, are wont to lift up their Shoulders: it is above the Clavicula.

It ariſes from the five tranſverſe Proceſſes of the Vertebra's of the Neck, with ſundry beginnings (which makes

makes it ſeem divers Muſcles) which ſoon grow into one : and its *Inſertion* is in the higher and lower corner of the Scapula, with a broad and fleſhy tendon. Its *Uſe* is, to draw forward and lift up the Scapula and the Humerus.

With theſe Muſcles the Scapula is moved directly or of it ſelf, and the *Brachium per accidens*, accidentally ; as the Scapula is accidentally moved by the Muſcles of the Brachium.

Chap. 4. *Of the Muſcles of the Cheſt, or which ſerve for Reſpiration.*

VEry many Muſcles ſerve for Reſpiration ; as the Midriff, all the Intercoſtal Muſcles, ſome of the Belly (of which I have treated in the firſt and ſecond Book) and ſome

Proper to the CHEST, which are reckoned *on each ſide* ſix ; to which nevertheleſs *Fallopius* adds three in the Neck ; which in *Veſalius* are parts of Muſcles poſſeſſing the Breaſt and Back.

The proper *Muſcles* of the Cheſt do grow thereto : two in the forepart, *ſubclavius* and *triangularis* ; *Serratus major* poſſeſſes the Sides ; the reſt are in the hinderpart, viz. the two *Serrati poſtici* and the *Sacrolumbus*.

I. The SUBCLAVIUS, becauſe 'tis ſeated under the Clavicula, fills the place between it and the firſt Rib. *Platerus* reckons it amongſt the Intercoſtals.

It *ariſes* fleſhy from the inner and lower part of the Clavicula : it is *inſerted* fleſhy into the upper part of the firſt Rib, which it draws upwards and outwards. And this is the firſt muſcle which dilates or diſtends the Cheſt. To this *Spigelius* aſſigns a contrary uſe, viz. to draw the Clavicula downwards, which nevertheleſs is of it ſelf immoveable, and therefore he aſcribes thereunto a Riſe and an Inſertion contrary to it.

II. The SERRATUS MAJOR, is a great, broad, and every way fleſhy muſcle, with the oblique deſcendent of the Abdomen, it makes a Saw-like Combination.

It *ariſes* fleſhy, from the internal Baſis of the Scapula. *Riolanus* hath obſerved an higher Original thereof, from the two upper Ribs, as far as to the Clavicula, which two Ribs ſeem immoveable. It is *carried* by its tendon, with five unequal ends, to the five true Ribs, and ſometimes to two baſtard Ribs ; which it lifts up. *Spigelius* alſo and *Veſlingus* do aſcribe a contrary Uſe hereunto, and conſequently a contrary Original, and Inſertion.

III. SERRATUS POSTICUS SUPERIOR *minor*, does quarter under the Rhomboides in the Back, between the two Shoulder-blades.

It *ariſes* membranous from the lower Spines of the Neck, and the firſt of the Back : it is *inſerted* into the three Intervals of the four upper Ribs, being tripartite : and it draws thoſe Ribs upwards.

IV. SERRATUS POSTICUS INFERIOR *major*, is membranous and broad almoſt in the middle of the Back, under the *Muſculus latiſſimus* or *Ani ſcalptor ariſing* from the Spines or ſharp points of the lower Vertebra's of the Back. It is *inſerted* into the Intervals of the four lower Ribs, being parted as it were into Fingers. Its *Uſe* is to widen the lower part of the Cheſt.

V. Is ſpred under the former, and by others ſuppoſed to be common to the Back and Cheſt. 'Tis called SACROLUMBUS, becauſe it *ariſes* from the lower part of Os ſacrum, and the ſharp points of the Vertebra's of the Loins. It is fleſhy within, nervous without. It is *inſerted* into the lower Ribs, with a double tendon, one external which is ſtrongeſt, the other internal. It is not eaſily ſeparated from the loweſt muſcle of the Back, ſo that it ſeems to be a parcel thereof. Its *Uſe* according to *Veſlingus*, to contract the Cheſt. *Spigelius* conceives as I do, that becauſe it grows out of one beginning with the *Muſculus longiſſimus* of the Back, that therefore it extends and raiſes up the Cheſt.

VI. Is the TRIANGULARIS, ſmall and ſubtile, in lean perſons ſcarce fleſhy, it lies inwardly concealed under the Breaſt-bone, out of the lower part whereof, it hath its *Original*. And therefore it may conveniently be called the Muſcle of the Breaſt-bone. Its obliquely *inſerted* into the lower Griſtles, which it draws to, and ſtraitens the Cheſt.

Chap. V. *Of the Muſcles of the Head.*

THE HEAD is *moved*, either ſecondarily by the muſcles of the Neck, according to the motion thereof ; or primarily upon the firſt Vertebra, to which it is immediately and cloſely joyned, bein, bent forward and backward. It is turned round upon the tooth-faſhioned Proceſs of the ſecond Vertebra (on which the hind-part of the Head reſts, and to which it is firmly faſtned) as it were upon an Axle-tree ; which motion is performed by nine pare of Muſcles.

The firſt pare is *long* and thick, by ſome called *Splenium*, ſpred out on each ſide upon the Vertebræ. It *ariſes* from a double beginning, one from the Spinæ of the upper Vertebra's of the Cheſt, another from the five lower Spinæ of the Vertebra's of the Neck, from which it is carried to the middle of the Occiput. Its *Uſe* is, to draw the Head directly backwards. But if only one do act, the motion is thought to be made circularly to one ſide.

The *ſecond* is implicated and complicated, and therefore termed *Complexum*. It ſeems to conſiſt as it were of three Muſcles. It hath divers beginnings, at the ſeventh Vertebra of the Neck, at the firſt, third and fourth of the Cheſt, and it is after a different manner implanted into the Occiput.

Riolanus obſerves touching the Fibres of the *Splenium* and the *Complexus*, that they are croſs-wayes interſected, and diſpoſed for the ſtrength of both the Muſcles.

The *third Pare* is ſcituate under the ſecond, *ſmall* and thick, which *Veſalius* would have to be the fourth part of the former Muſcle. It is *inſerted* into the hindermore Root of the *Proceſſus mammillaris*. Its *Uſe* is lightly to bring the Head backwards ; and if but one act, to bring it backwards to one ſide.

The *fourth* pare is called *Rectum majus*, being ſmall, fleſhy and lean. It *ariſes* from the ſecond Vertebra of the Neck ; *ends* into the middle of the Occiput.

The *fift* pare called *Rectum minus*, lies concealed under the former pare. Its *Riſe* is from the firſt Vertebra of the Neck, its inſertion and *Uſe* is as of the third and fourth.

The *ſixt* is the *Obliquum ſuperius*, which lies alſo beneath. It *riſes* according to ſome, out of the middle of the Occiput, and deſcending is inſerted athwart, into the points of the Proceſſes of the Neck. But others among whom *Veſlingus* do rightly think it ariſes from the Proceſs of the firſt Vertebra, and ends into the Occiput

ciput, by the outward side of the Recti.

The *seventh* called *Obliquum inferius, arises* from the second Vertebra of the Neck, and is *inserted* into the transverse Process of the first Vertebra.

The *Use* of the two oblique Muscles, is to bring the Head about to the Sides.

The *eighth* called *Mastoides, arises* long and round in the forepart of the Neck, for the most part double, from the upper part of the Brest-bone and the Clavicula: it is *inserted* with a fleshy and thick End, into the Mammillary Process, which it embraces. Its *Use* is to turn the Head.

A *ninth* pare is added by *Fallopius*, under the Throat, in the forepart of the Neck, lying near the first pare of the Neck. It *arises* nervous from the Ligaments of the Vertebra's of the Neck; and is *inserted* into the Basis of the Head, which it turns in like manner with the former.

Chap. 6. *Of the Muscles of the Neck.*

THe Muscles of the Neck are on each side *four*. The two first extend, the two others do bend the same.

I. The two LONG ONES lye hid under the Oesophagus or Gullet, arising from the first Vertebra of the Chest, with a beginning fleshy and sharp, they ascend into the extuberant Process of the first Vertebra, with an acute tendon, and sometimes are inserted into the Occiput, near its great Hole.

Its *Use* is, to bend the Neck right forwards and the Head withal: and if but one act, it turns it on the one side.

The SCALENI so called, which some count Muscles of the Chest, have a peculiar Hole, through which Veins and Arteries enter into the Arms. They *arise* fleshy, at the side of the Neck, from the first Rib; they are *inserted* inwardly into all the Vertebra's for the most part of the Neck, and especially into their transverse Processes.

III. The TRANSVERSALES *dub*, seated in the back, *do rise from* the six Vertebra's of the Chest which are uppermost and outmost: they are *inserted* externally into all the transverse Processes of the Vertebra's of the Neck. And between these Nerves go out. Their *Use* is, to extend or to bend backwards, but if one act alone, to move obliquely.

IV. The two SPINATI possess the whole Neck between the Spinæ, and are long and large. They *arise* from five Spines of the Vertebra's of the Neck, and seven of the Chest. They are strongly *implanted* into the whole lower part of the Spine of the second Vertebra. Their *Use* is the same as of the third pare.

Chap. 7. *Of the Muscles of the Back and Loins.*

THe *Spine of the Back* or *Back-bone* is moved forward, backward, to the right and to the left, and circularly. Yea, and in tumblers we may see infinite motions of the Back. For tendons are brought to all the Vertebra's, as though the Muscles were many and infinite; which tendons nevertheless many Anatomists do refer to some one great Muscle, and say that one Muscle hath many tendons. But commonly, they make four pare of Muscles of the back: where it is to be observed, if only one act, the back-bone is moved side-wayes, if the pare acts, it is either bended or extended.

The first pare is termed QUADRATUM, adhering to the transverse Processes of the Vertebra's of the Loins;

The FIGURE Explained.

This TABLE presents certain Muscles which do first offer themselves to sight in the Hinder-part of the Body.

aa. *The Muscles of the Head called Complexi.*
BB. *The Muscles called Splenij.*
CC. *The two Levators Scapulæ.*
D. *The Trapezius or Cucullaris out of its place.*
E. *The Supra-spinatus.*
F. *The Infra-spinatus.*
G. *The Rotundus major.*
h. *The Rotundus minor.*
II. *The Rhomboides.*
KK. *The Dorsi latissimus.*
L. *The Serratus posticus superior.*
M. *The Serratus posticus inferior.*
NN. *The Dorsi longissimus.*
OO. *The Sacrolumbus.*
P. *The Quadratus.*
Q. *The Sacer Dorsi musculus.*
R. *The Musculus longus which extends the Arm.*
S. *The Musculus brevis, the other Arm-extender.*
TT. *The Supinator Brachij alter, according to our Author, see the first pare in the next Table.*
V. *The Extensor Carpi primus, which some term Bicornis.*
W. *The Extensor Carpi secundus.* (here hanging down)
XXxx. *The two Extensores Digitorum.*
Z. *The External Apophysis of the Shoulder.*
Δ. *The Deltoides.*
T. *The Brachieus.*

These following Characters demonstrate the Muscles of the lower Limbs.

A. *The Glutæus major out of its place.*
B. *The Glutæus medius in its place.*
C. *The Pyriformis Musculus.*
D. *The Obturatus internus or Marsupialis.*
EE. *The Biceps which bends the Leg.*
g. *The Seminervosus.*
hh. *The Gracilis.*
III. *The Triceps of the left Side.*
K. *The Vastus externus.*
ΔΔΔ. *The Triceps of the right Side.*
LL. *The Popliteus.*
MM. *The two Castrocnemij, which on the left side are in their proper Scituation, on the right side out of the same.*
NN. *The Musculus soleus.*
O. *The Musculus plantaris.*

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between 164 and 165

Biceps; becauſe of
h is from the Scapu-
from the upper li
ader and leſs tendi-
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:d Brachiæus; its
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rimus and Longus,
, from the lower Rib
fleſhy in the Olecra-

ıs *ſecundus* and Bre-
the Humerus, is be-
and occupies the *Os*
: of the Olecranum on

us extendens, which o-
ourth Muſcle; but he
ıter Anatomiſts *Riola-*
term *Anconeus*. But
of his *Brachiæus*, be-
o the fleſhy Extremity
plitæus, that an equali-
the foot and the hand.
remity of the Shoulder,
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it is alſo *inſerted* by its
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e *Os Cubiti*.
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former.
dius is termed Rotun-
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ıg, it ends obliquely ve-
Radius, with a fleſhy
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: of the ſaid Radius.
reaching from the loweſt
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o fingers broad; it goes
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brenatores.
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wing ſharp, till it reach
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or Alter, growing from
ıe Arm, fleſhy, membra-
, and is *inſerted* into the
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The *Uſe* of the tw
Head about to the S
The *eighth* called
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from the upper part
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Mammillary Proceſ
to turn the Head.
A *ninth* pare is add
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the Neck. It *ariſes*
the Vertebra's of the
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Chap. 6.
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THe Muſcles of th
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I. The two LONG
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an acute tendon, and
Occiput, near its great
Its *Uſe* is, to bend t
Head withal: and if b
ſide.
The SCALENI ſo cal
of the Cheſt, have a
Veins and Arteries em

This TABLE
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aa. *The Muſcles of the*
BB. *The Muſcles called S*
CC. *The two Levators Sc*
D. *The Trapezius or C*
E. *The Supra-ſpinatus.*
F. *The Infra-ſpinatus.*
G. *The Rotundus majo*
h. *The Rotundus mino*
II. *The Rhomboides.*
KK. *The Dorſi latiſſimus*
L. *The Serratus poſticu.*
M. *The Serratus poſticu.*
NN. *The Dorſi longiſſim*

Theſe follo

A. *The Glutæus ma or*
B. *The Glutæus mediu.*
C. *The Pyriformis Muſc*
D. *The Obturatus inter*
EE. *The Biceps which be*
g. *The Seminervoſus.*
hh. *The Gracilis.*
III. *The Triceps of the le*

ariſing inwardly from the Bones Ilium and Sacrum, broad and fleſhy. *Riolanus* would rather bring them from the tranſverſe Apophyſes of the two lower Vertebra's of the Back, and the laſt Rib, that it might with the oblique deſcending Muſcles and the right ones, agitate and move forwards the Fabrick of the *Oſſa Ilij*. Howbeit, ſeeing that *Hypotheſis* is as yet uncertain, and himſelf confeſſes with *Cajus*, that the buſineſs is to be underſtood, of the bowing of the Loins, and the frame of the Ilian Bones; according to the Original by me aſſigned, the Uſe of this Muſcle is rather to bend the Vertebra's of the Loins.

The *ſecond* being called LONGISSIMUM, *ariſes* with an acute and ſtrong Tendon, without tendinous, within fleſhy, from the end of Os ſacrum, the Vertebra's of the Loins, and the Os Ilij; having the ſame beginning with the Sacrolumbus, wherewith it is in a manner confounded, til in the Progreſs it is ſeparated therefrom, by the loweſt Vertebra of the Back. And it is joyned afterward to each tranſverſe proceſs of the Vertebra's of the Loins and Back, unto which it affords tendons like *Claſpes*, and at length ends ſomtimes into the firſt Vertebra of the Cheſt, ſomtimes at the mammillary proceſſes, near the Temples-bone. Its *Uſe* is, to extend the Cheſt, Loins, and their Vertebra's.

The *third* under this, is that which is called SACRUM, becauſe it *ariſes* from the Os ſacrum behind, being fleſhy, and ends into the Spina of the twelfth Vertebra of the Cheſt (or as others ſay, into the Spines alſo, and oblique proceſſes of the Vertebra's of the Loins) with ſundry tendons. The *Uſe* is as of the former.

The *fourth* the SEMISPINATUM, *ariſing* where the former ends, and embracing all the Spines of the Vertebra's of the Cheſt, and giving them tendons; and *it ends* into the Spine of the firſt Vertebra of the Cheſt. Its *Uſe* is to rear up the Cheſt.

If all eight act, they hold the Back ſtraight, and do as it were ſuſtain a man. Nor are there any muſcles of the Loins, ſave theſe, and what have been explained before, which I have omitted, as *Riolanus* objects, or whereof I have been ignorant.

Chap. 8. *Of the Muſcles of the Cubitus and Radius.*

An Order in Diſſection.

THe *Muſcles* of the CUBIT, according to the arbitrary Method of Diſſection follow. Yet I do adviſe the Diſſector, that the Muſcles of the Radius are not to be ſhewed immediately after theſe, but laſt of all; but after the Muſcles of the Cubit, thoſe of the fingers, thumb and wriſt; becauſe the Muſcles of theſe parts being ſhewn and removed, the Inſertions of the Muſcles of the Radius, are more conveniently diſcerned. Otherwiſe the Brachium may follow next after the demonſtration of the Muſcles of the Cubitus and Radius, by an Order free for any one to follow.

The Muſcles of the Cubit are *four*, and of the RADIUS as many.

There are two Benders of the Cubit, as the *Biceps* and *Brachiæus*: two Extenders, viz. the *Longus* and the *Brevis*.

There are two Pronators of the Radius, the *Rotundus* and the *Quadratus*, and two Supinators, the *Longior* and *Brevior*.

For the proper Motion of the Cubit is flexion and extenſion. But the Radius makes the whole Arm prone or ſupine.

The firſt of the Cubit is termed BICEPS; becauſe of its double diſtinct *Beginning*, which is from the Scapula, the one tendinous and round, from the upper lip of the Acetabulum, the other broader and leſs tendinous, from the *Proceſſus ancoriformis*. And it is *inſerted* with the Head of the Radius, and poſſeſſes the inner part of the Arm with its Body. The tendon of this Muſcle ought in Blood-letting to be taken heed of.

The ſecond lying under this, and ſpred out upon the bone it ſelf, being ſhort, is called BRACHIÆUS; 'tis all fleſhy, leſs then the former; *ariſes* from the middle bone of the Brachium, and is before *inſerted* into the common beginning of the Cubitus and Radius, and the Ligament of the Joynt.

The third is the EXTENDENS *primus* and LONGUS, it *ariſes* with a double beginning, from the lower Rib of the Scapula, is ended being fleſhy in the Olecranum.

The fourth is the EXTENDENS *ſecundus* and BREVIS; it *ariſes* from the Neck of the Humerus, is behind mixed with the precedent, and occupies the *Os Humeri*; and it ends into the part of the Olecranum on which we lean.

Caſſerius adds a fift called *tertius extendens*, which others count a portion of the fourth Muſcle; but he counts it a diſtinct Muſcle, as later Anatomiſts *Riolanus* and *Veſlingus* do, which they term *Anconeus*. But he would have it to be a portion of his *Brachiæus*, becauſe it ſticks ſometimes cloſe to the fleſhy Extremity thereof, and to anſwer to the *Poplitæus*, that an equality may be maintained between the foot and the hand. It ſprings out of the hinder extremity of the Shoulder, by the end of the fourth and third Muſcle, and paſſing beyond the Joynt of the Cubit, it is alſo *inſerted* by its hinder and lateral part, yet not above a fingers bredth beyond the Olecranum, into the *Os Cubiti*.

Moreover *Galen* ſeems to add a fixt, which is the fourth Extender, viz. a fleſhy Lump hudled up of the two former, which *Riolanus* calls *Brachiæus externus*, to difference it from the *Brachiæus internus flectens*, becauſe being ſpred out upon the outſide of the Brachium, it is placed under the two former.

The firſt Muſcle of the Radius is termed ROTUNDUS, or *Teres*; from the inner Apophyſis of the Arm by a ſtrong and fleſhy beginning, it ends obliquely very near into the middle of the Radius, with a fleſhy end, and likewiſe a membranous tendon, which *Spigelius* writes, does go again to the middle of the Radius, and is knit to the outward ſide of the ſaid Radius.

The ſecond QUADRATUS, reaching from the loweſt part of the Cubita, into the loweſt of the Radius, wholly fleſhy, every where two fingers broad; it goes above that Ligament common to the Radius and Cubitus. Theſe are the *Manus pronatores*.

The third is the SUPINATOR PRIMUS, from the lower part of the Brachium growing ſharp, till it reach into the lower part of the Radius, fleſhy, where it is *inſerted* with a tendinous End.

The fourth is the SUPINATOR ALTER, growing from the outward Apophyſis of the Arm, fleſhy, membranous without, fleſhy within, and is *inſerted* into the middle wel-near of the Radius.

Among the Muſcles of the Radius *Caſſerius* once found two little ones, and very ſmall, about the Joynt Cubit, and proceeding in an oppoſite faſhion, and moving the Radius Prone and Supine like a Pulley. Howbeit, I found them not as yet. I have ſomtimes ſeen in their place, in a muſculous man, one *triangular*

Muscle, arising from the top of the Shoulder, and ending about the middle of the same, with a fleshy and narrow end, nor was it the portion of any Muscle, all which we had before diligently separated.

Chap 9. *Of the Muscles of the Wrist and Fingers.*

TO the *Muscles* of the WRIST and the *Hollow* of the Hand, is the *Musculus* PALMARIS referred, arising from the inner Apophysis of the Arm, with a round and tendinous beginning, spred almost over all the Muscles of the Hand, it is stretched out over the Hollow of the Hand, and cleaves exceeding fast to the Skin: where under the Skin in the hollow of the hand is a broad Tendon; whence proceeds that exquisite Sense which is in that part: and it ends into the first Intervals between the Joynts of the Fingers: it seems to have been made, that the Hand might take the better hold, when the Skin of the Palm is wrinkled.

To this they add the *Membrana carnosa* which they will have to open the Palm of the Hand when it is contracted; also a *four square Parcel of Flesh* growing out of that Membrane, resembling certain Muscles; either to extend the Palm when the Hand is open, as *Spigelius* conceives, or to make it hollow, which *Riolanus* would have.

The Muscles of the Wrist or CARPUS are *four*; two *Benders* which are internal; two *Extenders*, which are external.

The *first Bender* (which *Riolanus* calls *Cubiteus internus*, to whom we are beholden for these Names) arising from the internal Apophysis of the Arm, and being stretched over the Elbow, it is implanted with a thick Tendon, into the fourth Bone of the Wrist.

The other, *Radius internus* because it is drawn along the Radius, *arising* from the same *beginning*, *ends* into the first Bone of the Metacarpium, under the fore-finger.

The *Extensor primus*, or *Radius externus*, arises with a broad Beginning, from the external Apophysis of the Arm, and then growing more fleshy and spred out upon the Radius, and *ends* into a double Tendon, at the first and second Bone of *Os Metacarpi*.

The *other*, *Cubiteus externus*, from the same beginning, through the length of the Cubit, goes with one Tendon into the fourth Bone of the Metacarpe under the little Finger.

The FINGERS are *bended*, *extended*, *drawn to*, and *drawn away*.

Bended by the Muscles *Sublimis* and *Profundus*.

The *former* from the inner Apophysis of the Arm, before it comes to the Wrist, is divided into four Tendons, inclosed in a Ligament, as it were in a Ring: they are inserted into the second Joynting of the Fingers, a Cleft being first made, which the Tendons of the following Muscle do pass through, whence it is termed *Perforatus*, the bored Muscle.

The later spred out under the former and like unto it, is inserted through the Clifts of the former Tendons, into the Joynting. And therefore it is called *Perforans*, the Borer.

Concerning these Ligaments of the Fingers, it is to be observed. 1. That by an elegant Workmanship of Nature, a long slit is made in each of them, that the Ligaments of the third Joynting may pass through them

The Explication of the FIGURE.

This TABLE shews the rest of the Muscles, which are visible in the Hinder-part of the Body, those which lay by them or over them being removed.

aa. *The Muscles of the Head called* Recti minores.
bb. *The Recti majores so called.*
cc. *The obliqui Superiores.*
dd. *The obliqui Inferiores.*
α. *The Levator Scapulæ.*
β. *The Rotundus minor.*
δ. *The Serratus major.*
EE. *The Musculi transversales belonging to the Neck.*
ffff. *The Spinari duo.*
GG. *The Sacrolumbus.*
HH. *The Dorsi longissimus in its proper Scituation.*
II. *The same out of its place, that it may be seen.*
K. *The Semispinatus of the Back.*
LL. *The sacer Musculus of the Back.*
MM. *The Musculi Quadrati of the Back.*
N. *The first Supinator Brachij.*
O. *The first Extensor Carpi, or the Bicornis out of its proper place.*
P. *The other Extensor Carpi.*
QQ. *The two Extensores Digitorum out of their place.*
R. *The Extensor Indicis.*
SS. *The two Pollicem extendentes.*

These following Characters design the Muscles of the lower Limbs.

A. *The Glutæus medius out of its place.*
B. *The Glutæus minimus in its place.*
CC. *The same out of its place.*
DD. *The Pyriformis on both sides.*
E. *The Marsupialis, or Obturator internus.*
F. *The same in the left side out of its place.*
G. *The Marsupium neatly expressed.*
HH. *The Obturator externus.*
K. *The fourth of the Quadragemini, by the Author called* Quadratus.
LL. *The Biceps which bends the Leg.*
MM. *The Semimembranosus.*
NN. *The Seminervosus.*
OO. *The Gracilis.*
Δ. *The Musculus triceps.*
Γ. *The Crureus.*
PP. *The Tibieus posticus.*
QQ. *The Flexor Digitorum Pedis, Magnus or Perforans.*
R. *The Flexor minor or Perforatus.*
SSS. *The Flexor Pollicis,*
t. *The Pollicis Adductor.*
u. *The Pollicis Abductor.*
x. *The Abductor minimi.*
z. *The fleshy Mass in the Sole of the Foot.*

between 166 and 167

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TO the *Muſ*
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aa. *The Muſcle*
bb. *The Recti*
cc. *The obliqui*
dd. *The obliqu*
α. *The Levato*
β. *The Rotun*
δ. *The Serratu*
EE. *The Muſcu*
ffff. *The Spinar*
GG. *The Sacrol*
HH. *The Dorſi*

Th

A. *The Glutæ*
B. *The Glutæ*
CC. *The ſame*
DD. *The Pyrif*
E. *The Marſu*
F. *The ſame*
G. *The Marſu*
HH. *The Obtur*
K. *The fourth*
Quadratus.
LL. *The Biceps*
MM. *The Semin*

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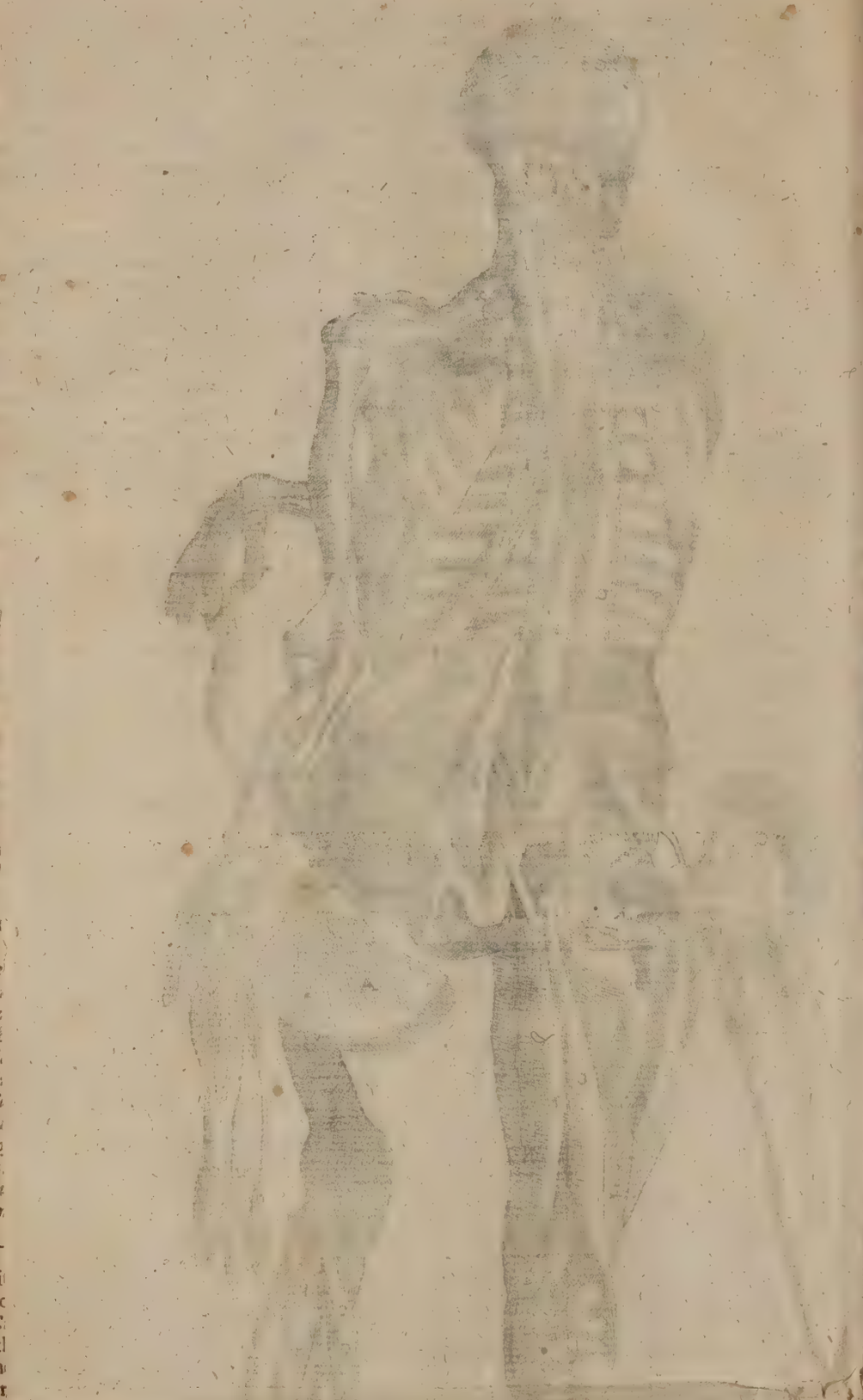

them as through an Arch. 2. That the membranous sheath does straitly embrace and keep in the said Tendons, least in the bending of the hand, they should be removed out of their place. 3. That a strong membranous Ring does in the wrist bind together all the Tendons internal and external, which being cut asunder, they are easily removed out of their places.

Iacobus Silvius reckons the *Extensores* for one Muscle; and calls it Tensor Digitorum, whereas both their Originals and Insertions do vary. They are two and arise commonly from the external Apophysis of the Arm, and the ring-fashioned ligament, and with their bored ligaments, being first collected, they are then *inserted* confusedly into the second and third joynt.

The Fingers are drawn to by four muscles called *Lumbricales* or *Vermiculares* worm-fashioned muscles, from their shape and smallness. They arise from the tendons of the *Musculus profundus*, and being drawn out along the sides of the fingers, they are obliquely carried unto the third joynting. *Spigelius* and *Vestingus* will have them to be inserted by a round tendon only into the first joynting, whom I have somtimes found to be in the right, their tendon being mixed with the membranes of the interjuncture.

The *Abductores interossei* are six, in the spaces of the Metacarp, three external and three internal, which joyning with the vermiculary do go along the outsides and insides of the fingers, and stretch their tendons to the three inter-joyntings. They serve in some measure for extension. The *External* rest upon the Palm, the *Internal* upon the hollow of the Hand, between the bones of the Metacarp.

The *Muscles* which bend the *Thumb* are two.

The first *arising* from the upper part of the radius is inserted into one of the joynts.

The other *arising* from the wrist bone, under the Thumb, is *inserted* into the middle of the said Thumb. It lies wholly under the former.

There are two *Extendentes* or stretchers out, which arise from the Cubit. The first reaches unto the third Interjuncture, the other unto the second, and the rest, with many tendons; sometimes one, sometimes two, and otherwhiles three.

The *Abducentes* are three; two arising from the Metacarpium, and the third from the bone of the Metacarp, which looks towards the forefinger: which *Riolanus* calls *Antithenar*, as the other the former of the bringers to, *Hypothenar Pollicis*.

The *Abducentes* or drawers away are three nameless muscles, save that the said *Riolanus* calls one of them *Thenar*.

The *Forefinger* has two proper muscles, which some confound, the first is the Abductor, arising from the first Interjoynting of the Thumb, and terminated into the bones of the Forefinger, wherewith the said Forefinger is drawn from the rest of the Fingers, towards the Thumb.

The other is the *Indicis extensor* the stretcher of the Forefinger which *Riolanus* calls *Indicatorem* the pointer, as also *Vestingus*, though he confound it with the Abductor. It *arises* from the middle and external part of the Cubit, and *ends* with a double tendon, into the second interjointure of the forefinger.

There are also two muscles proper to the smallest finger, the *Abductor* and *Extensor*. The former may be parted into many: It arises in the hollow of the hand, from the third and fourth wrist bones of the second rank, and ends externally into the side of the first joint of the said finger. *Aquapendent* and others that have since followed him, do hold that it draws the little finger outwardly, from the rest. *Extensor proprius*, which *Riolanus* exactly seperates from the great one, *arising* from the upper part of the radius, and carryed along Cubitus and the Radius, is externally inserted into the finger, with a double tendon.

Chap 10. *Of the Legg and Thigh in generall.*

PES the Leg and Thigh, is all between the Buttocks and the Toes of the Feet: Others call it *magnus pes*, the great Foot, and *Crus*. It is *divided* into its parts, as the Arm, in a manner not unlike, viz. Into the *Femur*, *Tibia*, and *Parvus Pes*. *Pes what?*

Again the *Parvus Pes* is divided into *Pedium*, *Metapedium*, and *Digiti*.

The *Use* of the Leg and Thigh, is to be the Instrument of walking: which is performed by stirring and sitting. For one Leg being firmly set upon the ground, we move and bring about the other, and our Foot being firmly fixt, keeps us from falling; and so we come to walk. The setting therefore of our Leg is the Motion of the whole Body, but the motion proceeds from the Leg, which the length or shortness of the Leg does either help or hinder; and therefore birds because they were to flie, that their bulk might not hinder them, they have a short Thigh and long Feet, which makes the going be slow. But Men go slower then Dogs, beause the successive putting on of their Foot from the Heel to the Toes, slackens their motion; whereas Dogs with one motion of their little Feet do pass along. Some do conceive that the length of a womans Leg helps to generation. Now there is an Incision made into our knees and heel, that we might not go leaping.

This Motion is variously made by the muscles of the Thigh, Leg and Foot. We are therefore now to treat of the Muscles of the whole Leg.

Chap 11. *Of the Muscles of the Thigh.*

THe *Thigh* is *bended* by two Muscles.

The first is in the Belly, and is termed *Psoa* or the *Musculus Lumbaris* it arises with a fleshy beginning from the upper Vertebraes of the Loins, and is *inserted* into the forepart of the small Trochanter, with a round and strong tendon.

The other muscle called *Psoas* minor I found in a strong fleshy body at *Hafnia*, 1651. differing from that which *Riolanus* brags to have seen. For the greater part it lay under, but outwardly inclined more to the sides. The *beginning* was fleshy, and the whole muscle was three fingers broad. It was *inserted* fleshy, into the upper brim of Os Ilij backwards, where the *Iliacus internus* arises. I conceived that its *use* was to spread as a pillow under the greater muscle, because the Os Ilij is of it self immoveable, or to hold the Os Ilij upright, that it might not burthen a man too much when he stands. *Michael Lyserus* a most expert Anatomist can witness the same with me.

The *Iliacus secundus* is inserted in the same place, with a tendon which grows to the tendon of the precedent muscle, *arising* from the whole internal cavity of the Os Ilij, by a small and fleshy beginning.

The

The Thigh is extended by three muſcles of the Buttocks termed *Glutæi*.

I. Is the *Major, externus & ampliſſimus*, beginning at the Crupper, the ſpina of Os Ilij, and the Os ſacrum; and ends into the Os Femoris, under the great Trochanter.

II. The other is the *medius* or middlemoſt in Scituation and Magnitude. It ariſes from the inner ſide of the Spina of Os Ilij, ending into this great Trochanter with a broad and ſtrong tendon.

III. The third called *minimus* the ſmalleſt, lies concealed under the middlemoſt; It *ariſes* from the back of Os Ilij near the Acetabulum with a broad and ſtrong tendon, and *Ends* into the great Trochanter.

Theſe three do make up the fleſhy Subſtance of the Buttocks.

The Thigh is drawn to, and wheeled about inwards by three muſcles, which many do reckon for one, and call it *triceps* triple headed, becauſe of its threefold beginning. 1. Is from the upper joynting of the Os pubis. 2. Is from the loweſt joynting of Os pubis. 3. Is from the middle part of the ſaid bone. They are *inſerted* firſt of all into the inner head of the Thigh-bone, near the Ham, with a round tendon or into the rough line of the Thigh. 2. To the upper, partly; 3. Partly to the lower, at the Rotator minor. *Riolanus* has other inſertions: For he will have the firſt to be inſerted into the middle of the Thigh, the ſecond to be produced with a very ſtrong Tendon as far as to the End of the Thigh, the third below the neck of the Thigh-bone.

To theſe *Spigelius* and *Veſlingus* do add one which they call *Lividus* ariſing at the joyning of Os pubis, near the Griſtle, and implanted with a ſhort tendon, into the inner ſide of the thigh: but they grant that this is a portion of the Triceps. But they do ill to reckon it among the bending Muſcles. But *Riolanus* calls it *Pectineus* and reckons it for a bender, yet acknowledges that it is the uppermoſt and fourth portion of the triceps, which with *Fallopius* he divides into four Muſcles, and indeed it ſeems to have ſo many parts.

It is drawn away and turned about outwards by ſix Muſcles; the *Quadrigemini* and the two *Obturatores*.

The *Quadrigemini* are in a manner one like another, and little, placed as it were athwart, *ariſing* from the lower and outer part of the Os Sacrum, the bunch of Os Iſchij, and the Appendix of the Hip-bone. They are *inſerted* into that ſpace which is between the two Trochanters. The firſt Quadrigeminus is called *Pyriformis* Pear-faſhioned, becauſe of its ſhape, and *Iliæus externus* from its Scituation; the reſt want names, ſave the fourth, which is called *Quadratus*.

The *Obturatores* ſtoppers, take up the wide hole between the Os pubis and Os Iſchij. And they are external or internal, the former ariſing from the outer Circle of the hole of the ſhare: the latter from the inner and they are inſerted into the great Trochanter: the inner may be termed *Burſalis* or purſe-faſhioned becauſe it hides the fourfold tendons in a fleſhy purſe as it were, neatly ſhaped by the third and fourth quadrigeminal Muſcles.

Chap. 12. *Of the Muſcles of the Legg.*

THe *Leg is bent* by the four muſculi poſtici.

One of them has two *Heads*, termed *Biceps*, the *firſt* from the joyning of the Os pubis, the *ſecond* from the outer part of the thigh, and both of them are *inſerted* with one tendon, the fleſhy ſubſtance being firſt increaſed in the middle, into the hinder part of the Leg.

The ſecond called *Semimembranoſus ariſes* from the ſwelling of the Iſchium, and is inſerted into the inner ſide of the Leg, backwards.

The third is the *Seminervoſus*, and has the ſame beginning and the ſame end with the former, ſave that in the hinder parts it is carried little forward obliquely, before it terminates at the inſide of the Leg.

The fourth is the *Gracilis*, which is inſerted into the ſame place, and ariſes from the joyning of the ſhare-bone.

Four Muſcles *extend* the Leg.

The firſt is the *Rectus*, ariſing with an acute tendon from the outer and lower Spine of the Ilium.

The ſecond and third are the two Vaſti, the *external* ariſing from the whole root, the great Trochanters, and the bone of the Thigh which lies under: the *Inner* from the ſmall Trochanter: they are terminated on each hand at the ſide of the *Rectus*.

The fourth is the *Cruræus*, fixed to the Thigh bone, as the *Brachiæus* is to the Brachium.

Theſe four Muſcles, are *terminated* into one tendon, which embracing the ſubſtance of the fleſh into it ſelf, it is inſerted before into the beginning of the Leg, and is there inſtead of a Ligament for it.

Two Muſcles, pul it to, inwards.

The firſt is the *longus, faſcialis* or *ſartorius* which *Spigelius* and *Veſlingus* reckon among the benders, on which Tailors or Botchers reſt themſelves when they ſit croſs-leg'd. It is well nigh the longeſt of all muſcles, *ariſing* from the former Spina of Os Ilij, and *deſcending* obliquely unto the inner and fore-part of the Leg.

The other is the *Popliteus ariſing* from the lower and outer extuberancy of the Thigh, and being *inſerted* four-ſquare into the inner and upper part of the leg obliquely.

The *Abductor* is one, which is called Membranoſus and *faſcia lata*.

It *ariſes* fleſhy from the Spina of Os Ilij, and is *carried* obliquely, into the outer part of the Leg, and with its moſt broad and long tendon, inveſts well-near all the Muſcles of the Thigh.

Chap. 13. *Of the Muſcles of the Feet.*

THe *Foot* is bended and extended. Two muſcles bend it forwards.

The *firſt* is termed *tibiæus anticus*, affixed to the Leg ariſing from the upper proceſs thereof, it is *inſersed* into the Os Pedij, before the great Toe, with a tendon which at the end is divided into two.

The other is *Peroneus biceps*, which others count for two muſcles, one head ariſing from the upper Epiphiſis of the Fibula, the other from the middle of the Perone. It has a double tendon the leſſer carried into the bone of the little toe; and the greater going obliquely under the ſole of the Foot, is inſerted into the Os pedij juſt againſt the great toe.

'Tis extended backwards by the four *Poſtici, duo gemelli*, the internal and the external, called Gaſtrocnemij, becauſe they conſtitute the ankle, and ariſe from the inner and outer head of the thigh under the Ham. The *third* being cal'd *ſoleus* is added to theſe beneath, ariſing

ariſing from the hindermore appendix of the fibula. Theſe three muſcles are terminated into a moſt thick and ſtrong tendon, to be inſerted into the beginning of the Heel and Pterna, by which beaſts being killed, are uſually hung np. *Hypocrates* did term it *chorda* : where by reaſon of the fracture of the Heel, he ſayes that hiccuping and convulſive feavers do follow.

The laſt is called *plantaris* and anſwers to the palmaris in the hand ; it is lean and meagre, and degenerates into a long tendon, and covering the whole ſole of the foot, it *ariſes* from the outward head of the Thigh bone, under the Ham : and is *inſerted* into the five toes, and has the ſame uſe here which it has in the Hand : though the compariſon of one to the other holds not out very exact. *Veſlingus* has obſerved that this muſcle has ſometimes been wanting.

The *Tibiæus poſticus* muſt be added to theſe, which *Spigelius* reckons amongſt the oblique movers, and *Riolanus* among the extenders.

Chap. 14. *Of the Muſcles of the Toes.*

THe Toes of the foot are moved by muſcles, as well as the fingers of the hand.

Two muſcles *bend* the Toes , the *Magnus* which anſwers to the profundus, ariſing from the upper Epiphiſis of the Tibia, under the ſole is divided into four tendons, which boreing through the minor, they are implanted into the third Articulation of the four toes. The *Minor* anſwering to the ſublimis, is the midſt of the ſole of the foot, *ariſing* from the lower part of the pterna or heel bone, it is carried into the ſecond articulation of the four toes , to which before it comes it is bored thorough, that it may tranſmit the tendons of the foremoſt Muſcle : and therefore this is called perforatus, the other perforans.

One muſcle *extends* the four toes of the foot , which is by ſome divided into two ; ariſing from the upper and outer part of the tibia , and having four tendons, which are inſerted into the ſecond and third Interjuncture.

The four *wormfaſhioned* Muſcles do *draw them to*, anſwering to thoſe in the Hand, ſome fleſh being interſprinkled from the Heel : They are faſtned by ſo many tendons to the firſt interjoynting.

The ten *Interoſſei* do draw them away , *ariſing* from the bones of the pedium, and falling the void ſpaces of the Metapedium , they are external or internal , the former with a broad tendon do ariſe by the ſides , to the firſt interjoynting of the toes by the ſides ; the latter at the ſecond interjoynting ; but the ninth *ſerves* for the drawing-to of the great Toe , the tenth for the drawing to of the little toe.

The *great Toe* has peculiar muſcles.

It is *bent* by one only , proceeding from the upper part of the fibula, and inſerted into the third interjointing (*Riolanus* ſayes the firſt) of the great toe.

It is *extended* by another , ariſing from the middle of the Fibula (or as ſome ſay from the outſide of the tibia, where it recedes from the Fibula) which is oftentimes divided into two tendons.

It is *brought* to, with one , inwardly faſtned to the greateſt bone of the pedium.

It is *drawn away* by one *ariſing* fleſhy from the inner part of the heel, and *entring* extrinſecally into the firſt bone of the great toe.

Now there is a *new muſcle* found out above the Interoſſeans, the firſt Inventor whereof is *Caſſerius* ; who calls it *tranverſalis*, becauſe of its ſituation. *Veſlingus* call it the *Adductor pollicis minor*, which uſe nature ſeems to have intended.

It *ariſes* nervous and broad, from the ligament of the firſt interjuncture of the little Toe, and ſometime from one of the toes next the little toe ; and by and by becoming fleſhy and ſo continuing, it is carried athwart over the firſt joints of the fingers, and with a ſhort and broad tendon, it is *implanted* into the firſt joynt of the Great-toe, a little inwards.

The *Uſe* hereof is, to ſecure our walking, when we paſs through rough wayes, full of round flints, or over any other ſmall, ſlippery, or rowling paſſage. For by help of this muſcle, the foot does accommodate it ſelf, to the figure of the Bodies we tread on , and layes hold thereon as it were, that it might make its paſſage more ſtead-faſt.

The *Abductor* of the little toe , ſticking in the outſide of the foot broad and vaſt , ariſing from the ſame part of the heel, is inſerted into the outſide of the firſt Interjuncture.

I have obſerved a peculiar *bender* of the little toe , long, round, ariſing from the head of the Tibia , and divided with two tendons about the inſertion of the toe.

Finally a *fleſhy maſs* is to be obſerved in the ſole of the foot, as well as in the Palm of the hand, wherewith our footing is faſtened as with a cuſhion , and the tendons of the muſcles do lie hidden, in a ſoft Pillow.

THE FIRST MANUAL Concerning the Veins,

Answering to the

FIRST BOOK OF THE Lower Belly.

ABove, in the Proæm of this Anatomical work, I promised *four Books*, and *four little Books or Manuals*. Four *Books* touching the three Cavities and the Limbs; Four *Manuals*, *viz.* touching the *Veins*, *Arteries*, *Nerves* and *Bones*. Now every Manual answers to its Book. Because from the lower Cavity, namely, the principal part thereof, the *Liver* arise the *Veins*; from the Heart in the middle Cavity the *Arteries*; from the Marrow in the third Cavity the Nerves, and to the Limbs the Bones do answer. And even as the Bones joyned together do make a peculiar Fabrick or Skeleton, representing the form of the whol Animal; so also do the Veins, Arteries and Nerves. And *Gulielmus Fabricius Hildanus* a Famous Chyrurgeon hath such a Frame of all the Veins of the Body artificially separated; and at *Padua* by the Instruction of *Ad. Spigelius*, and *John Veslingius*, and *John Leonicenus* such Frames of the Veins Arteries and Nerves seperated from the body, are commonly to be seen at *Padua*; and the like is to be seen here at *Hafnia* acurately made, and explained in four very great Tables, in the Custody of the renowned D. D. *Henricus Fuiren* my Cosin Germane.

The *Veins*, *Arteries* and *Nerves* are Organs or common vessels of the Body, through which some spirit, with or without Blood, is carried from some principal member, into sundry parts of the Body.

Chap. 1. *Of a Vein in General.*

What a Vein is?

A *Vein* is a common Organ, round, long, hollow like a channel or Conduit pipe, fit to carry or bring back Blood and Natural Spirit.

The term *Vein* was by the *Ancients* given both to Veins and Arteries; but they cal'd the Arteries pulsing Veins, and the Veins not pulsing Veins. and some called Vein, the greater Vein, and an Artery the lesser Vein and the *Aorta*.

The *Efficient* of a Vein, is the proper vein-making power or faculty.

The *Matter* according to *Hippocrates* is a clammy and cold portion of the Seed. And this is the principle of a Veins Original.

'Tis proved against Aristotle that the Liver, not the Heart is the Original of the Veins.

But the *Principle* of Dispensation from whence the Veins arise, is the *Liver* (not to speak of some ancient triflers, who would derive the Veins from the Brain) and not the Heart, as *Aristotle* would have it. For,

Blood is not made in the Heart.

1. Blood is made in the Liver. And therefore 'tis like the original and rise of the Veins is there. and that the first sanguification is not made in the Heart is apparent, because there are no passages to conveigh the Chylus to the Heart; again there are no receptacles for the Excrements of the first concoction placed by the Heart. But all these requisites are found in the Liver.

2. Blood is carried from the Liver to the Heart, but not from the Heart immediately to the Liver. For Blood cannot go out of the Heart into the Liver, because of the Valves; though mediately when it runs back out of the Arteries, it may be carried thither.

3. Fishes have no right Ventricle in their Hearts, in which they would have Blood to be made; and out of which they would have the Veins to arise, and the Fishes have both Veins and Blood.

4. The *Vena portæ* touches not the Heart but the Liver, which the *Cava* also touches: which two Veins are the greatest in the whole body. But according to *Aristotle*

ſtotle all Veins ought to be continued with the Heart. You wil ſay; the *Vena arterioſa* does not touch the Liver. I anſwer, neither ought it ſo to do: becauſe it hath the ſubſtance of an Artery, and therefore ariſes from the Heart. But *Arteria Venoſa*, is a Vein in ſubſtance and uſe, and in the Child in the womb, was continued with the *Cava*.

5. In the Child in the womb, the Navil-vein with Blood goes into the Liver, not into the Heart.

6. If the Veins ſhould ariſe from the Heart, they would pulſe as the Arteries do, for the whole Heart pulſes.

7. Sanguification is never hurt, but when the Liver is hurt, as in a Dropſie, &c.

Theſe are the chief reaſons for this Opinion: but many other reaſons of other men againſt *Ariſtotle* I reject as weak and eaſily refuted, as alſo many weak reaſons of the Peripateticks, againſt this Opinion which we aſſert, which any one may eaſily anſwer, if he be at leaſt but lightly skilled in Anatomy.

The Uſe of the Veins. According to the Ancients.

The *End* and *Uſe* of a Vein is,

I. According to the Opinion of the Ancients, to carry Blood and Natural Spirit with the Natural faculty, from the Liver into all parts of the Body to nouriſh the ſame.

According to later Authors the Primary Uſe.

But Nature hath revealed otherwiſe to their Poſterity; for neither do the Veins carry any thing from the Liver to nouriſh the parts with, nor is the Venal Blood uſeful for nutrition. But they bring back all the Blood, only to the Heart by *Circulation*, either mediately by the Liver, as the Meſaraick Veins, or immediately, as the *Cava*; and that either from the whole body, from the ſmalleſt branches to the greateſt, by the upper and lower branch; or from the Liver whether it be there generated, or is derived from the Meſaraicks and Arteries.

And that they bring the Blood to the Heart as to the Centre, and that they bring it from the ſmalleſt parts as from the Circumference, is evidently provided by ocular Inſpection, Experiments, and Reaſon.

1. In Blood-letting, the Arm being bound above the Elbow, beyond the Ligature, the Vein ſwels not, nor if you ſhould open a Vein would the Blood flow out (which is to be obſerved in oppoſition to the Authority of *Scribonius Largus*) unleſs very little, or if there were ſome Anaſtomoſis of a Vein, with an Artery in ſome parts above. But on this ſide the Ligature under the Elbow, both the Veins of the Arm ſwel, and being opened they void as much Blood as you wil, yea all that is in the body. Likewiſe if with your finger you preſs the Vein below the Orifice, the blood ſtops, if you take away your finger it runs again: whence we gather that the blood runs from the outmoſt ſmall Veins of the body upwards unto the great Veins and the Heart; and not from the upper and greater Veins into the lower, ſmaller, and more remote.

2. Without Blood-letting, the Veins being preſſed with the finger ſhew as much: for if in an Arm either hot, or whoſe Veins naturally ſwell, you force the blood downwards with your finger towards the fingers, there follows no blood in the upper part of the Vein, but it appears empty. Contrariwiſe, if you force the blood from the Fingers-ward upwards, you ſhall preſently ſee the Veins full, more blood following that which you forced up.

3. If you ſhall plunge your Arms and Legs into cold Water or Snow, being firſt bound, when you unbind the ſame, you ſhal perceive your Heart offended and made cold, by the cold blood aſcending thereunto; and it will be warmed if you put your Legs or Arms as aforeſaid into hot water. Nor is it any other way by which cordiall Epithems applied to the Wriſts and Privities do good.

4. In perſons that are hanged, their Heads and Faces become red, the Veins being diſtended, becauſe the recourſe of the Blood into the Heart is hindred; as in opening of the Veins of the Head, the upper parts in the Head ſwell, the other parts towards the Heart being empty. But the Halter being looſed from the dead body, the ſwelling and redneſs of the Face does fall by little and little, unleſs the Blood which is forced into the ſmalleſt Veins cannot run back again becauſe of the coldneſs of the parts.

5. In Diſſections of Live-Animals, the matter is moſt evident. For in what part of the body ſoever you bind a Vein, it appears lank and empty on that ſide of the Ligature next the Heart, and on the other ſide it ſwels where it is furtheſt from the Heart, and neereſt the extream parts of the Body.

6. In a living Anatomy, if you lift up a Vein and open it being tied, beyond the Ligature plenty of Blood flows out, on this ſide nothing at all, which you ſhall find true in the crural and jugular Veins of any Creature whatſoever, though you cut the Veins quite in ſunder, as I have often experimented with the great *Walæus*, and *Harvey* was not ignorant thereof.

7. The Valves of the Veins do conſpire to this end, which are ſo contrived, that they ſtand all wide open towards the Heart, and afford an eaſie paſſage from the ſmalleſt Veins to the greateſt, and from thence to the Heart. But from the Heart and great Veins, being ſhut they ſuffer nothing to go back, no not Water driven by force, or a Probe, unleſs being hurt they gape.

8. The Liver ſends only to the Heart; the Heart only to the Lungs, and all the Arteries; as hath been already demonſtrated concerning the Heart. Seeing therefore the Blood by continual pulſation is ſent in ſo great quantity in all parts, and yet cannot be repaired by Diet, nor can return back to the Heart by reaſon of the Miter-faſhioned Valves of the *Aorta*, nor abide ſtil in the Arteries which are continually driving the ſame, nor finally is there ſo much ſpent by the parts to be nouriſhed; it follows, that what remains over and above is brought back again to the heart, and enters the Veins by Circulation. Whereof although ſome dark Footſteps are extant in the writings of the Ancients, as I have proved in my Book *de Luce Animalium*, and *Walæus* and *Riolanus* do afterward declare the ſame at large; yet it hath been more cleerly manifeſted in this Age of ours to that moſt ingenious Venetian *Paul Sarpias Fulgentius* as relates from his papers, and ſoon after to *Harvey* an Engliſhman, to whom the commendations and praiſe of firſt publiſhing the ſame to the World and proving it by many Arguments and Experiments, are juſtly due, finally to *Walæus* and others approving the ſame.

The *Primary* End therefore of the Veins is to carry and recarry Blood unto the Heart the *ſecondary* ends may be theſe following.

Their ſecondary Uſe.

II. A little to prepare the ſaid Blood, as do the *Rami Lactei*, or to finiſh and perfect the ſame; as a ſmall portion of *Vena Cava* between the Liver and the Heart.

III. To preſerve the Blood, as the proper place preſerves that which is placed therein, as much as may be in a ſpeedy paſſage, and to retain it within its bounds. For extravenated Blood, or Blood out of its natural place, *viz.* Veins and Arteries, curdles and putrefies. Alſo in the Veins themſelves, when they are ill affected, and the courſe of the Blood is ſtopped, ſomtimes the Blood is found congealed, witneſs *Fernelius*: ſomtimes a fatty ſubſtance is found inſtead of Blood, as in the Nerves, which *Bontius* ſaw among the Indians.

IV. Some would have the red veins to make Blood, and the milkie veins to make Chyle, but they are quite miſtaken.

The *Form* of the Veins is taken from ſundry Accidents.

Its

Figure. Its *Figure* is that of a Conduit pipe.

Magnitude. Its *Magnitude* varies. For the Veins are great in the Livet, as in their Original; in the Lungs becauſe they are hot, ſoft, and in perpetual motion, and thereſote they need much nouriſhment, becauſe much of their ſubſtance ſpends; but eſpecially becauſe all the Blood in the Body paſſes this way, out of the right into the left Ventricle of the Heart, as hath been proved already. In the Heart by reaſon of its heat, and becauſe it is to furniſh the whole Body with Arterial Blood, received in and ſent out by continual pulſings. Alſo the emulgent Veins are great, by reaſon of plenty of blood and ſeroſities, which is brought back from the Kidnies to the *Vena Cava*. But where the ſubſtance of a part is laſting, and is not eaſily diſſipated, by reaſon of the ſmal quantity of Heat, the Veins are leſſer as in the Brain, where the Veins do not alwaies eaſily appear, and in the Bones, where they never manifeſtly appear, though the Animal be great.

In all parts towards the ends they are very ſmall, and are divided into Capillary Veins, ſprinkled into, & commonly confounded with the fleſh, that the ſuperfluous Blood may be better received into them; which is *one* way, by which the Arterial Blood is mediately paſſed through the porous fleſh to the Veins, which way alſo Blood made of Chyle in the Liver, is infuſed into the little branches of the *Vena Cava*. The *other* is, by the Arteries immediately. For,

Connexion. The *Connexion* is ſuch with the Arteries, that every Vein is for the moſt part attended with an Artery, over which it lies and which it touches. *Galen* tels us a a Vein is ſeldom found without Arteries; but no Artery is ever found without a Vein.

Anaſtomoſis of Veins and Arteries. But there is in the Body a mutual Anaſtomoſis of Veins and Arteries: that they may conſpire together, and the Veins receive out of the Arteries Spirit & Blood; which is apparent from reaſon, becauſe, 1. If the Veins be quite emptied, the Arteries are empty alſo. Moreover out of a Vein opened in the Arm or Hand, all the Blood in the Body may be let out, which, becauſe it cannot be contained or generated in the Hand, it muſt neceſſarily come out of the Arteries beneath and round about, by means of the Anaſtomoſes: whereof this alſo is a token, that if the Vein and Artery of the Arm be tied very hard, the Blood ceaſes running and the pulſe ſtops it beating, til the band be ſlackned. 2. They are neceſſary in reſpect of the Circular motion of the blood, ſeeing the pores of the Fleſh are not ſufficient, ſave in a ſlow courſe, and ſubtile Blood.

Moreover they may be demonſtrated in many places to the Eye-ſight, where the Conjunctions of the Veins with the Arteries are viſible, viz. in the Brain, in the *Plexus Chorides*, the Cavities, in the Lungs of the *Vena Arteriosa*. and the *Arteria Venoſa*, with the Branches of the *Aſpera Arteria* or Weſand. Of the Thoracick branches deſcending, with the intercoſtal Veins. Alſo the Hypogaſtrick Veins aud Arteries, with the Mammary veſſels are joyned mouth to mouth under the *Muſculi Recti* in the Abdomen. But the Anaſtomoſes or mutual conjunction of the mouths of the *Cava* and *Portæ* in the Liver, and of the Veins and Arteries in the Spleen, are in a ſpecial manner manifeſt; ſo in the Veins of the Womb, the ſeminary veſſels, the Navil-ſtrings, and the extremities of the Hands and Feet.

Anaſtomoſes of the Veins in the Liver. Though the *Anaſtomoſes* or conjunctions of veſſels, are in reaſon neceſſary, and manifeſt to the Eye-ſight, yet are they not all *manifeſtly diſcernable* by the Sight.. I made experiment in the Liver of an Ox and of a Man, diligently ſeparating all the ſubſtance from the veſſels; yet could I not either with a Probe, or a Knife, or a pair of Bellows find the *Anaſtomoſes* of *Vena Cava* and *Vena Porta* open, but all blind, in dead bodies, though it is not to be doubted, but that they are open in in living bodies, where all the paſſages are inlarged by Heat.

This TABLE preſents the *Anaſtomaſes* of *Vena Cava* and *Porta* in the Liver.

TABLE I.

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The Explication of the FIGURE.

A. *The deſcending Trunk of Vena Cava and Porta in the Liver.*

BB. *The Vena portæ.*

C. *The Gall-Badder.*

dddddd. *The greater branches of Vena Cava Diſſeminated through the Liver.*

eee. *The branches of Vena Portæ.*

ffff. *The firſt Paralel Anaſtomoſis of the Vena Cava with the Vena Portæ.*

gg. *The ſecond Anaſtomoſis of Trunk with Trunk.*

hh. *The third croſs Anaſtomoſis.*

ii. *The fourth Anaſtomoſis mixt.*

kk. *The fifth Anaſtomoſis, which is oblique or angular.*

Of sundry kinds.

I found them to be of divers kinds. The first *Paralel* when the utmost twigs are joyned one to another in right lines. The *second* is of Trunk with Trunk, a transverse vessel going between. The third is *cross-fashion'd*, when either the Branches go over the Trunk, or the Trunk go over the Branches cross-wise, or the Branches over the Branches in the same manner. The fourth is mixt of the Cross-fashion'd and the oblique. The fist is oblique or angular, when the Branches are mutually inserted obliquely. I have before explained the Anastomoses of the Navil-vessels. Now the *Anastomoses* between the Veins and Arteries, are either in the Trunks or the Capillary Vessels.

Why the Veins are in some places invested with Coats, in others not.

The Veins are somtimes invested with a common Membrane, or some external thick one, borrowed from the Neighboring parts, when either they are suspended and carried a long way, and are without the Bowels and Muscles; or when they rest upon hard bodies. This happens in the lowest Belly, to the Veins and Arteries from the *Peritonæum*, and in the Chest from the *Pleura*.

But where a Vein is inserted either into some Bowell or a Muscle, it needs not this common coat, because 1. It is otherwise sufficiently susteined. 2. Otherwise the ready sweating through of the blood would be hindred. 3. And the laying down of the Excrements of the Vein. 4. It would not so soon be sensible of the force of the substance of any Bowell. 5. It would more hardly imbibe the Blood which is superfluous after the nourishment of the parts.

Now the Veins being so compassed with Membranes do *not feel* (unless they have Nerves neer them) of themselves and by their own Nature, neither the acrimony of the Humors contained, nor cutting or burning. And therefore *Aristotle* saies in his third Book *de Historia Animalium* chap. 5. A Nerve cannot endure the Fire, but a Vein can. And *Galen* in his sixt *de usu partium* chap. 12. saies that if Veins and Arteries be cut, burnt, or tied, they feel it not at all.

CHAP. II.

Of the Substance of the Veins and of the Valves.

THe *Substance of the Veins* is Membranous, that they may more easily stretch and shrink in again.

They have only one *Coat*, which is proper to them (the Arteries have two) being thin and rare; because through it the blood is to be received after the parts are nourished. it carries not back such stirring and hot blood as the Arteries carry; because it is grown cold and returns quietly to the Heart without any beating of the Pulse that it may be there again perfected.

Whether the Veins have Fibres.

Some conceive that a Vein is interwoven with a triple kind of Fibres: but they ad, that those fibres are there obscurely, and only potentially, nor can be moved out of their place, by reason of the most strait contexture. But I rather conceive with *Vesalius*, that others imagin Fibres to be there, which are no more there than in Leather. for when we pull the substance of the Reins all in pieces, no fibres are there to be seen. But some Authors attribute fibres to the Veins, because they have præconceived this opinion, that Attraction, Expulsion and Retention are performed by sundry sorts of fibres, whenas the fibres if they have any are to strengthen them.

Harvey and *Walæus* do suspect that the Blood in the Veins is driven to the Heart, by the fibres, which nevertheless I conceive to be done, by the motion and contraction of the Muscles, with which the Veins are mingled, they not resisting. Yea, and it may be driven by the blood continually following, from the parts and Arteries moved by the Pulse. But others alleadge attraction to be made by heat, without the fibres.

Who first observed the Valves in the Veins.

Within the Veins are found certain *Valves* or *little folding Gates*, which *Bauhine* saies are mentioned by *Avicenna*, under the name of Cells. *Aquapendens* saies himself was the finder of them in the year 1574. to whom *Paulus Servita* or *Sarpi* the *Venetian* gave the first hint though it seems apparent by his *Isagoge*, that *Jacobus Silvius* had also some knowledg of them. But after him or with him mention was made of these Valves by *Salomon Albertus*, *Archangelus Picholhomineus*, and *Casperus Bauhinus*; *Laurentius* doth hardly once speak of them.

How the Valves of the Veins were found.

The occasion of *Aquapendents* finding of them was this: he observed that if he prest the Veins, or by rubbing endeavored to force the Blood downwards, its course did seem to be stopped. Also in the Arms of persons bound to be let Blood, certain knots apper to swell by reason of the Valves; and in some persons, as Porters and Plough-men, they are seen to swel in their Thighs like the Varices.

The Cause of the Varices.

And here seems to consist the Cause of the Varices; because thick Blood and by its heavines unapt to move upwards, being long retained in the Valves, makes a dilatation of the said Valves: for without the Valves the Veins would swel uniformly and all of an equal Bigness, and not in the manner of Varices.

And because this Doctrine of the Valves in the Veins, is known to few, I shall propound the same more exactly, according to my manner of handling rare subjects.

The Valves of the Veins what?

These *Valves* are most, thin little Membranes (thicker in the Orifices of of the Veins of the Heart) in the inner Cavity of the Veins; and certain particles as it were of the coat of the Veins; because there the body of the Veins is most thin, where those Membranes do go from it.

Where they are not found at the original of the Veins?

They are *seated* in the Cavity of the Veins, but especially in the Veins of the Limbs, *viz.* of the Arms and Legs, after the Kernels of the Arm-pits and and Groyns. Beginning presently after the rise of the Branches, not in the Rises themselves. Now there are two found in the inner orifice of the jugular Vein, looking from above downwards; the rest look from below upwards, as many in the *Cephalica*, the *Basilica*, and in the Veins of the Legs and Thighs.

Why Valves are not found in the Trunk of Cava, the jugulars, the external small Veins, nor in the Arteries?

No Valves are found in the Trunk of *Cava*, because the Valves placed in the Divarications do sufficiently hinder the regress of the Blood, nor doth the Trunk make any delay. nor are there any in the Jugulars (besides those aforesaid in the Orifice of the inner Veins) because the venal Blood of it self heavy, doth hardly ascend upwards, nor doth it there need any stop. In like manner there are none in the external small Veins; because in regard of their smallness, they needed none, nor is there any danger of the Bloods regress, by reason of the neerness of the parts and Arteries which drives the same. We also with *Harvey* have found Valves in the emulgents, and in the Branches of the Mesentery, looking towards the *Vena cava* and *Porta*. Nature endeavored the same in the Milkie Veins; also Dogs and Oxen have them in the division of the crural Veins. Also there are none in the Arteries, because in them there alwaies is and ought to be

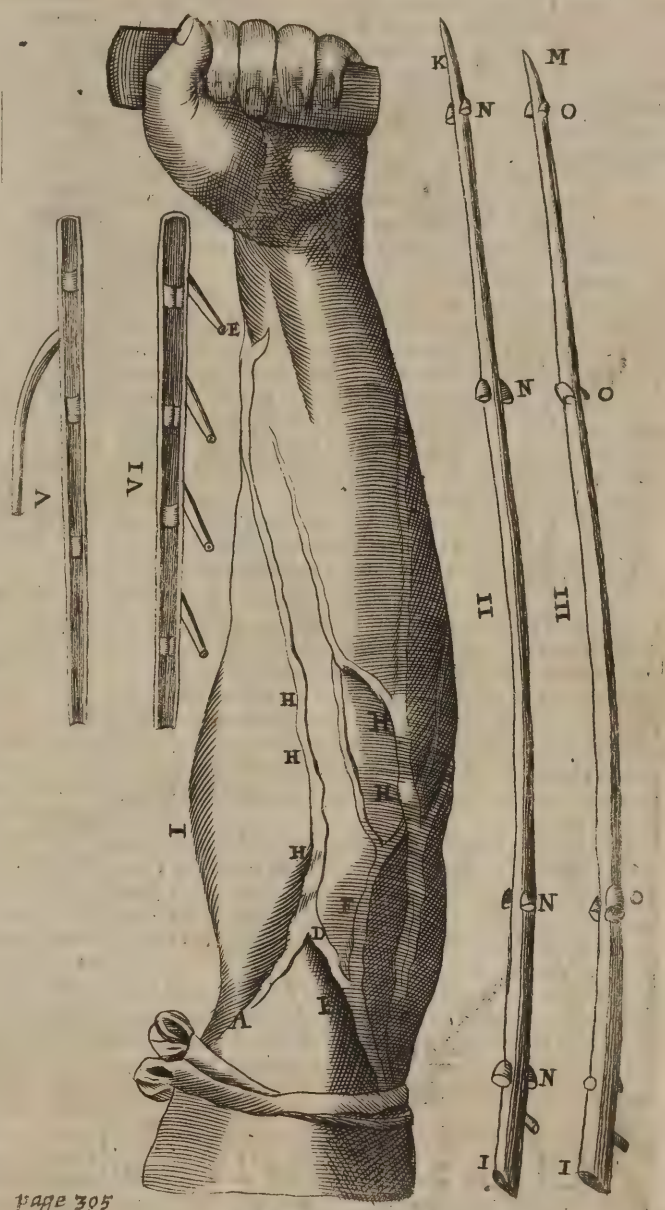
a Flux

The FIGURE Explained.

TABLE II.

This TABLE in Fig. 1. shews the Valves of the Veins in a bound Arm, in Fig. 2. and 3. The crural Veins the inside outward, with their Valves.

A. *A Branch of the Vena Cephalica.*
BF. *A part of the Vena Basilica.*
D. *The Vena Mediana.*
E. *A Branch of Vena Cephalica, to which the Mediana was joyned.*
HHHH. *Represent the knots in the Veins, caused by the Valves there placed.*
IK. *One Crural Vein.*
LM. *The other Crural vein.*
NNNN. *The valves of the Veins fil'd with Cotton-wool.*
OOO. *The said valves of the Veins empty.*
FIG. V. *Shews the single valves of the Vena Basilica looking upwards.*
FIG. VI. *In the Crural vein opened double valves are seen.*



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a Flux of spirituous Blood, which begins successively and ends with the Systole and Diastole of the whole Body; nor is there any thing to urge a Reflux; moreover the the Arteries are of themselves sufficiently strong. Yet I have sometimes observed the footsteps of a Valve in the Artery of the Arm, and it may be to stay the Blood running in the Arteries in that subject, that it may not return, as we see in the beginning of the *Aorta*, and the *Vena Arteriosa*.

Now the Valves are so situate, that they have their Orifices upwards towards the roots of the Veins, and are shut beneath, and alwaies look towards the Heart. And the workmanship of Nature is remarkable in their situation, in that they have their postures looking the same way one following another, as knots in the Branches and Stalks of Plants, that is to say, they are not in a right line one against another, or placed on the same side, least the whole Blood should flow streight in through the free part of the vessel. So the lower Valves do stop, what the upper have let slip: and if all the doors of the Valves had been disposed in one right line, there had been little or no delay made in the regress.

Moreover they are situate at Distances, according to the length of the vessel, sometimes two, three, four, or five fingers distance; that if the Blood by some default should be compelled to flow backwards, and should pass the upper Valves, falling on upon the other Valves following, it might be stopped and hindered.

Their Magnitude. As to their *Magnitude* they are greater where by reason of the plenty of Blood the Recourse is most vehement, and therefore greater inconvenience was to be feared to happen, either to the parts which would be too much oppressed, or to the Heart least it should be destitute of Blood; as we see in the *Basilica* and in the Crural Vein at the Groyns.

In what Persons there are most Valves. The *Number* of all the Valves varies, as also their distances; for there are more Valves in those

1. Who abound with melancholly Blood, or contrarily with very cholerick and thin Blood; because both those humors do not only easily resist the Driver, but when they are driven, by their weight and tenuity, they easily flow back.

2. In great or more fleshy Bodies and consequently having more Veins.

3. In such as have the broadest vessels.

4. In such who have long and streight Veins; for in such as are oblique, the crookedness of the vessels gives some stop to the running back of the Blood.

Moreover, the number of Valves in one and the same place doth not exceed two. For they are seated at distances, sometimes one, otherwhiles two at most; not at any time three, as we find in the Vessels of the Heart: because in the Heart a greater orifice is to be shut, and the Ventricle underneath is larger, yea and the greater violence of the Blood in the hot Heart, did require more stops; But in the progress of the Veins, their Branching diminishes their Magnitude, and the blood is slower in

motion. Therefore where the Veins are yet pretty big, and there is danger from the plenty of Blood, there are two doors, but otherwise but only one.

Its Figure. Its *Figure* likens the Nail on a Mans finger or the horned Moon, such as you see in the figma-shap'd Valves of the Heart.

Substance. Its *Substance* is exceeding thin, but withall very compact, lest they should break by a strong incourse of the blood. And this is apparent from the Varices, where they can contein the blood a very long time.

Use. The *Use* is I. To strengthen the Veins, whereas the Arteries are otherwise made strong by the doubleness of their coats.

II. The chief use according to *Aquapendent* and most Anatomists following him, is to stop the motion of heavy and fluid Blood, which runs violently into the Arms and Thighs, and Legs, because of their downward position; but especially in most vehement motion and exercise, where through the power of exceeding heat, the Blood would rush impetuously into the Limbs, and so 1. The inner and more noble parts would be defrauded of their nutriment. 2. The Veins of the Limbs would be too much stretched, and in danger of breaking, and consequently the Arms and Legs would be alwaies swelled.

According to Harvey. But this use is rejected by *Harvey*, because 1. In the Jugulars they look downwards. 2. In the emulgent and Mesenterick branches, they look towards the *Porta* and *Cavæ*. 3. There are none in the Arteries. 4. Dogs and Oxen have the same, in the division of the crural Veins, in whom because of their going downwards, there is no such thing as aforesaid to be feared. 5. The Blood of its own accord is slowly enough driven, out of the greater Veins into the lesser Branches, and out of hotter into colder places. And therefore according to his principles, and the principles of Circulation, the use of the Valves is,

III. Lest the Blood should move out of the great veins into the little ones and so tear them; or from the Centre of the Body into the outmost parts, but rather from the extremities to the Centre. And therefore they do the same thing in the Veins, which the Sigma and Miter-shap'd Valves do in the Heart.

But in the Orifice of the Jugular Vein internal they perform the same Office, least in the bowing back of the Head, the Blood should return into the Brain, and like a Flood oppress the same, disturb the Animal Functions, and breed a sanguine Apoplexy.

Chap. 3. *Of the Division of the Veins of the Body, and of the* Vena Portæ *and the* Venæ Lacteæ.

ALL the Veins of the whole Body are referred unto two as their Mothers; *viz.* the *Vena Portæ* and the *Vena Cava*, to which is joyned a third kind of vessels found out by *Asellius* viz, the Milky Veins, of which we shal speak by and by.

The *Vena Portæ* its Original and *Root* is the *Vena Umbilicalis*, of which I spake *in the first Book*, the first of all the Veins, arising from the Seed.

The Vena Portæ, why so called. Now it is termed *Vena Portæ*, or *Quæ ad Portas est*, the Gate-vein, and Vein at the Gates, and *Vena ostiaria*, the Door-vein; because through the roots thereof, or, as others wil have it, its branches, *viz.* the Mesaraick Veins, the Chyle being sukt out of the Stomach and Guts was anciently thought to be carried, as it were by Gates into the Liver. The Arabians cal'd it *Vena Lactea*, because they thought it drew the Chyle, white like Milk.

This is the greatest Vein in the Body next the *Cava*, and is commonly said to arise out of the hollow part of the Liver. And it is not so compact as the *Cava*, but more loose and soft.

It is divided into the *Trunk* and *Branches*.

The Branches of the Portæ in the Liver, termed Roots. The Branches are *upper* and *lower*: and some call the former Roots, others the latter.

They call the former Roots, because this Vein is said to have its original out of the Liver: the latter, because as Roots suck matter out of the Earth, and carry it into the Trunk of the Tree: even so also the *Venæ Meseraicæ*, which are the lower branches of *Portæ*, do suck Chyle like Roots (according to the Ancients, but according to our late opinion blood out of the Mesentery) and carry it to the Liver by the Trunk and upper Branches; and therefore the Meseraick Veins are termed the *Livers Hands*. We may therefore call them all, both branches and roots, in a different respect.

The upper Branches, four or five of them are spred up and down the hollow part of the Liver, which afterwards, beneath and without the Liver, grow into one Trunk. Touching these and their Anastomoses, see above, *in the Chap. of the Liver, Book the* 1.

The *Trunk* before it is divided into lower Branches, sends two small Veins to the Gall-bladder which are termed *Cystica gemellæ*; another Vein to the Stomach, which is therefore cal'd *Gastrica dextra*.

Afterward the *Trunk* inclining to the left hand, it is *divided* into two remarkable lower Branches: the one higher and lesser, going towards the left side; the other lower and larger on the right side.

The Spleen-Veins of the Stomach. The former is called *Splenicus*, because it goes into the Spleen, & before it is divided it spreads from it self two upper Branches to the Stomach, the *Gastrica minor* and *Gastrica major*, the largest of all the Stomach Veins, which afterwards constitutes the *Call.* the *Coronaria*. Then it sends lower branches to the *Call* and one to the *Pancreas*. *Pancreas.*

These being thus constituted, the *Truncus Splenicus* is divided, into the upper and lowe Branch. The former produces the *Vas breve* and other little branches carried into the Spleen. The latter produces two Veins for the Call and Stomach which are termed *Epiplois sinistra* and *Gastroepiplois sinistra*. Finally, the rest of its small branches, are spent up and down in the Spleen. *Spleen.* *Call.* *Stomach.*

Of the Stomach. Call. Guts. The *Ramus dexter* of the *Vena portæ*, before it is divided, produces two Veins, 1. To the right side of the Stomach and Call. 2. To the Guts, *viz.* the middle of *Duodenum*, and the beginning of the *Jejunum*: whence certain capillary twigs go through the Pancreas and Call upwards.

Of the Mesentery. Afterwards an whole large Branch goes into the Mesentery, and being carried between the two coats thereof, it is distributed into three notable Branches, called *Rami mesenterici*, the Mesenteric branches.

The Meseraick Veins. The right-hand mesenteric branch is two-fold, which spends it self into fourteen nameless branches, and these again into innumerable Off-springs of Veins termed the *Meseraick Veins* in the Guts, *Jejunum*, *Ileon* and *Cæcum* and part of *Colon*, whose

Their Use. *Use* is, 1. According to the Ancients, to suck the Chylus out of the Guts, and to carry it by the Trunk of *Vena portæ* into the Liver. but the milkie juyce of the Chylus is never

TABLE III.

The FIGURE Explained.

This TABLE shews the Branchings of the *Vena portæ* within and without the Liver.

AAA. *The Trunk of the Vena portæ going out of the Liver.*
bbbbb. *Its branchings in the Liver.*
C. *The Umbilical or Navil-vein.*
D. *The Vena Cystica.*
e. *The Implantation of the Coronary Vein of the Stomach.*
FF. *The right Branch of the Vena portæ.*
G. *The left splenick Branch therof.*
h. *The Rise of the Coronaria of the Stomach, which after it hath bestowed many branches upon the Stomach it self, being turned back towards the Pylorus, it is implanted into the Trunk of the Vena portæ it self, where the letter* e *stands.*
iii *Little branches of the Vena splenica, distributed through the Pancreas.*
kkkk. *The manifold ingross of the said Vena splenica into the Spleen.*
L. *The Vas breve so called.*
m. *The Gastroepiploica sinistra, which runs out upon the bottom of the Stomach, and affords many branches both to to the Stomach it self, and to the Call.*
n. *The Vena Epiploica sinistra.*
ooo. *Little branches disseminated through the bottom of the Stomach.*
ppp. *Branches which run out through the Call.*
q. *Another Epiploica superior to the precedent, for it runs before it, through the lower part of the Call, which comes neerest the Loyns.*
R. *The Rise of the internal Hæmorrhoidal Vein, which*
SSS. *Diffuses Branches through the Mesentery, and at last where this mark stands ⋈ it sends forth the Hæmorrhoid Veins so called.*
V. *The Gastro-epiploica dextra, from which many branches arise that are disseminated through the Call and Stomach.*

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never found in these, they being alwaies full of Blood. Moreover the finding out of the Milkie Veins is repugnant to this Use. Howbeit in time of necessity when the milkie veins are totally obstructed, *Riolanus* grants that the Chylus is carried by these without any Argument. For they do not open themselves into the Guts, for then blood would be poured into them, and in my judgment, nutrition should rather cease, as we see in the Lientery, when they are obstructed.

According to Harvey.

Harvey to refute the milkie veins, and withall to maintain his Circulation in the Mesentery, does suppose that as the Navil-veins draw in alimentary juyce from the Liquors of the Egg, and carry it to nourish and increase the Chick; even so the Mesaraick Veins do suck Chyle out of the Guts, and carry it into the Liver, even in a grown person. But then they should carry Chyle and Blood together, and so divers juyces would be jumbled together, such as were digested with those that are indigested. And what need is there to confound Vessels that Nature hath distinguished. And every one knows, that the use of the Navil-vessels, is different in a Child in the womb and a grown person.

2. According to the same Antients, to prepare the said Chyle in some measure, and to give it the rudiments of Blood. which would be true if the Hypothesis were true.

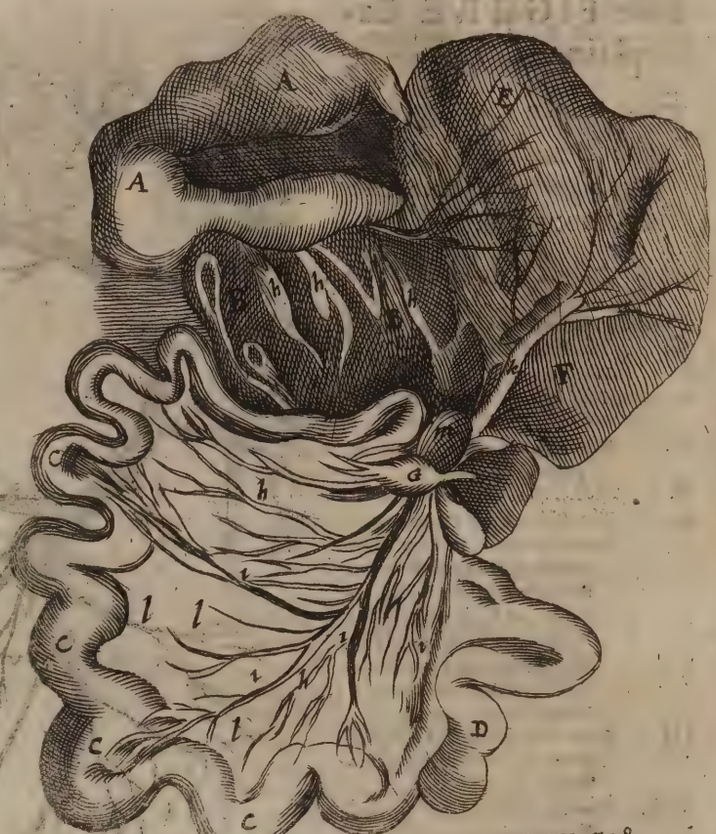
3. According to the said Ancients, to carry the Blood back from the Liver, to nourish the Guts. But so a contrary

The Explication of the FIGURE.

This TABLE represents the milkie Veins in the Fish cal'd *Orbis*, or the Lump-fish.

AA. *The Stomach.*
BB. *Appendixes of the Stomach in which the Venæ Lacteæ or milkie Veins are evident.*
CCCC. *The Guts drawn to one side.*
D. The Intestinum Rectum or *Arse-Gut.*
E. *The Liver.*
F. *The third Lobe of the Liver, into which the milkie veins are inserted.*
G. *A white kernell of the Mesentery swelling with Chyle, out of which Veins are carried unto third the Lobe.*
hhh. *The milkie Veins.*
iii. *The Branches of the Mesaraick Veins.*
k. *The Trunck of the Vena portæ.*
lll. *The Mesentery.*
m. *The Gall-Bladder.*

TABLE IV.



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trary motion would happen the same way, at the same time, *viz.* of the Chyle to the Liver, and of the Blood back again to the Guts, and those humors being confounded would hinder the motion of one another. I forbear to say, that this blood not being perfected in the Heart, is unfit for nourishment.

4. According to others and my Father *Bartholinus* amongst the rest, to carry thick blood made in the Spleen from thence to the Guts to nourish them. which were true did not the Circulation teach otherwise, which hath been found out since his time. And that same blood would be more fit to nourish, by reason of the abundance of Arteries in the Spleen. The Vessels being changed, this Opinion would be absolutely true.

5. *Asellius*, who rightly assigns the milkie veins to carry Chyle to the Liver, hath shewn that these common mesaraick Veins do serve to no other intent, then to bring blood out of the Liver to nourish the Guts. which use, being before refuted, he is therein to be excused, who was likewise ignorant of the true motion of the blood.

6. Their true *Use* is to bring the Blood back after the the nutriment of the Guts, into the Liver, which had bin carried to the Guts, by the mesaraick Arteries. This is apparent by Ligatures in living Creatures, which *Walæus* practised, in which they swell towards the Liver, but are empty towards the Guts. The *Valves* shew as much, which were by *Harvey* found out in the mesaraick veins, looking towards the Cava and the venæ portæ, which *Columbus* also observed, and which hinder the blood of vena portæ from passing into the Guts. Nor does the Conflux of humors out of the Body about the Guts hinder, whither the Humors flow thither of their own accord or provoked by medicaments; because this passage of the Humors is certainly through the mesenterick Arteries which neither *Spigelius* denies, nor those that maintaine the Circulation of the Blood.

The *left* Mesenterick branch is spread abroad into the left and middlemost part of the Mesenterie, and part of the Colon from the left side of the Stomach, and to the *Intestinum rectum.* Hence arises the *Vena Hæmorrhoidalis* interna so called, of which in the following and proper Chapter.

The History of the Milkie Veins.

This Age of ours being clearer sighted then the former, has found out the milkie Veins in the Mesentery so called, from the white colour of the Chyle in them, which besides the Mesaraicks, make a fourth kind of vessels, through which the Chylus is carried into the Liver. *Erasistratus* in *Galen* had a glimpse of these veins, but after him, the first that discovered them was *Caspar Asellius* an Anatomist of *Ticinum*, in the dissection of a living dog well fed, on the twenty third of *July* in the yeer 1622. In whose footsteps accurate Anatomists treading, who prised nothing more then truth, have found by testimony of their eyes, that those same vessels full of a milkie juyce, are peculiar passages different from the Mesaraicks. For in living Creatures they are allwayes to be seen, if they be dissected about four hours after they have been well fed, viz. when the Chylus is distributed: for after that time they are not to be seen, howbeit, though empty, they alwaies appear like little fibres which have deceived some, making them to take these vessels for nervs: but they are out, because nervs neither have such a Chyle as this, nor Valves nor any cavity. Nor are the Mesentery and Guts so sensible, although they have a few nervs from the sixt

Conjugation

Conjugation. Some have conceived these vessels to be Arteries, but contrary to sense, which acknowledges here a simple coat, and no motion. Only the not knowing of their Trunk, does keep some learned men as yet in suspense, which if it could be demonstrated to be in the Liver, they would be of our mind. But although their Trunk and Original be unknown yet no man should doubt of the existency of these Veins any more then the Inhabitants about *Nilus* doubt of the Existency of that River, whose Head is unknown. And others account it no impossible thing, that they may by their twigs be implanted into the Liver without any Trunk. Yea and it seems not improbable to the renowned *Kyperus* and *Regius*, that the milkie veins being confounded with the Mesaraicks in the *Pancreas* or great kernel, do there empty their Chyle into the *Vena Portæ*, and so it is carried by the Veins into the Liver, that it may be mixed with the *Fermentum* brought from the Spleen, and so receive the Rudiments of Blood. But I shal by and by shew that the milkie veins have branches which reach into the Liver, where they are inserted.

The History of the Vena Lacteæ.

But I will briefly relate the History of these milkie veins, following the guidance of *Asellius* and others, and mine own Experience, who have diligently viewed them, in live Animals, and Men newly hanged and choaked.

Their Name.

These vessels are termed *Lactes* or *Lactea Vasa* also *Venæ lacteæ* either from *Lacio* a word out of date, signifying *Allicio*, I draw, or *a lacte* from Milk, which they resemble in whiteness, softness and fatness; even as the Ancients and later Writers have given the same name, to the small Guts, the mesaraick Veins, and the Mesentery, for the same cause, though the agreement and verity be not the like.

They were quite unknown to the Ancients, if you except *Erasistratus*, who in Kids that had lately sukt, saw certain obscure Arteries which were soon filled with milk, yet most Ancients were ignorant, that there were one sort of vessels to carry the Chyle, and others to carry the Blood. But they may be easily excused, by indifferent Censurers, because they commonly dissected Animals that had been strangled, in which bodies, unless they be tied, they suddenly disappear. *Galen* who had made more than six hundred live Anatomies, did without doubt take them for Nerves.

Their Situation.

Their *Situation* is in the lower Belly, where they are for the most part accompanied with Fat, which cherishes that Heat which is necessary for the attraction and preparation of the Chylus.

They are carried through the *Mesenterium*, from the Guts, by an oblique passage, between its two coats, partly separate from the other vessels, partly together with them, sometimes streight along, otherwhiles going over the same, and cutting them crosswise as it were, through many Kernels, placed chiefly at the parting of the branches; they are carried, I say as far as to the *Pancreas*. In the *Pancreas* or great kernel of the Mesentery, which *Asellius* after *Fallopius* calls *Pancreas*, they are wreathed and wrought together like a Lattice, this way and that way, into very many and those inexplicable wreathings and Labyrinths.

From thence again, having sent greater branches by the sides of *Vena portæ*, and sometimes also twigs to the *Vena Cava*, they enter with small Branches into the Cavity of the Liver. From thence, being carried to the Liver it self, and split into very small fibres, they are so long spred up and down into the flesh thereof, every way, til they are at length quite obliterated.

Their Insertion in the Liver.

But into what part of the Liver, either the Trunk or Branches are inserted, I have not found by any as yet determined, by reason of the sudden Efflux of the Humors. I, in the dissection of the fish cal'd *Orbis*, by our Country-men Steenbud, by *Gesner* Sea-Hare, by *Clusius* the frog-mouth'd Orbis, by the *Islanders* Roemasue from the color of its Belly; both Male and Female here at *Hasnia* frequently repeated, in the presence of the most learned *Wormius*, *Sperlingerus*, *Simon Pauli*, *Fuerinus*, and others, have found and demonstrated not only many daies after, great plenty of milkie veins, full of the white milkie humor, but also the true place of their Insertion. which was the third *Lobe* of the Liver, that same little soft one described by *Spigelius*, into which there entred a milkey branch sufficiently great, from the large kernel seated not far off, and swelling with the milkey humor, unto which kernel, the most of the milky veins out of the *Mesemery*, and the appurtenances of the Stomach, had their Course. Nor is it to be doubted, but that the same betides in men and other Creatures Nature so sharing the business, that to each Lobe its Trunk may be assigned. Now from this they go further, with the branches of *Vena portæ*, inwardly to the rest of the Lobes, and their *Parenchyma*. And it is to be observed, that about this third Lobe, where the milkey veins are inserted, the Gall-Bladder is placed, either to assist Concoction which begins there, or to receive the cholerick Excrement, which in the Concoction of the *Chylus* is separated therefrom.

Now they are inserted into all the Guts, yea even the *Duodenum*, but especially into the smaller Guts, not so many into thick ones, nor are any of them carried to the Stomach or the Spleen. And least the Chylus once received should slip back again into the Guts, they are furnished with Valves which look from within outward, which wil not admit the Chyle though driven back with Violence.

Its Substance.

Its *Substance* is of a Vein, which it resembles in structure and all things else, excepting the milkie juyce. Of which there are three compounding parts, *Fibres*, a *Membrane*, and *Flesh*. They have but one single Membrane, wherein they differ from Arteries, neither are they here cloathed with so thick a coat, no more than in other remote parts, though in the Mesentery they receive from it another external coat. *Asellius* doth attribute to them all kinds of fibres, Right, Transverse, Oblique, for Drawing, Retaining, and Expelling; though *Walæus* by Ligature do teach, that tha Chyle is rather thrust in them to the Liver, by the Guts contracted and driving the same; and others conceive that it is drawn by the Liver it self.

The *Flesh* which grows to the Membrane, fils up the spaces between the fibres, whose *use* besides is, to prepare the Chyle before it comes to the Liver.

Their Quantity.

As for *Quantity* they grow continually one to another, being all of one Trunk though their magnitude be not equal, some being greater others lesser. Now they are small, least the thick and unprofitable parts of the Chyle, should go into them together, and least distribution should be made too suddenly and tumultuously, which *Frambesarius* observes.

Number.

They are infinite in *Number*, dispersed through the Liver, Guts, Mesentery and *Pancreas*, and so much more in number than the vulgar Mesenterick Veins, that their plenty may make amends for their smallness.

As to the first active Qualities, they are colder than ordinary Veins, because the Chyle which they carry is colder than Blood. In respect of the *passive* qualities, they are dry, yet moister than the common Veins.

In respect of *the second Qualities*, they are thin and exceeding subtile, where they enter into the body of the Liver; Tender, Smooth, Rare, Rough by reason of the Fibres within them. From these qualities follows their colour which is white, partly because they were made of cold seed, partly because of the white Liquor which they carry, For

The Explication of the FIGURE.

This TABLE Represents the milkie Veins, or *Venæ Lacteæ.*

AA. &c. *The Meſaraick branches of the Vena portæ, and the branches of the Arteria Cœliaca, which accompany the ſame.*

BB &c. *The Venæ Lacteæ or milkie Veins, which being bound in the lower parts do diſcover the Valves.*

CC. *The Nerves running up and down through the Meſentery.*

D. *The Bottom of the Stomach.*

E. *The Pylorus.*

F. *The Gut Duodenum.*

G. *The Gut Jejunum.*

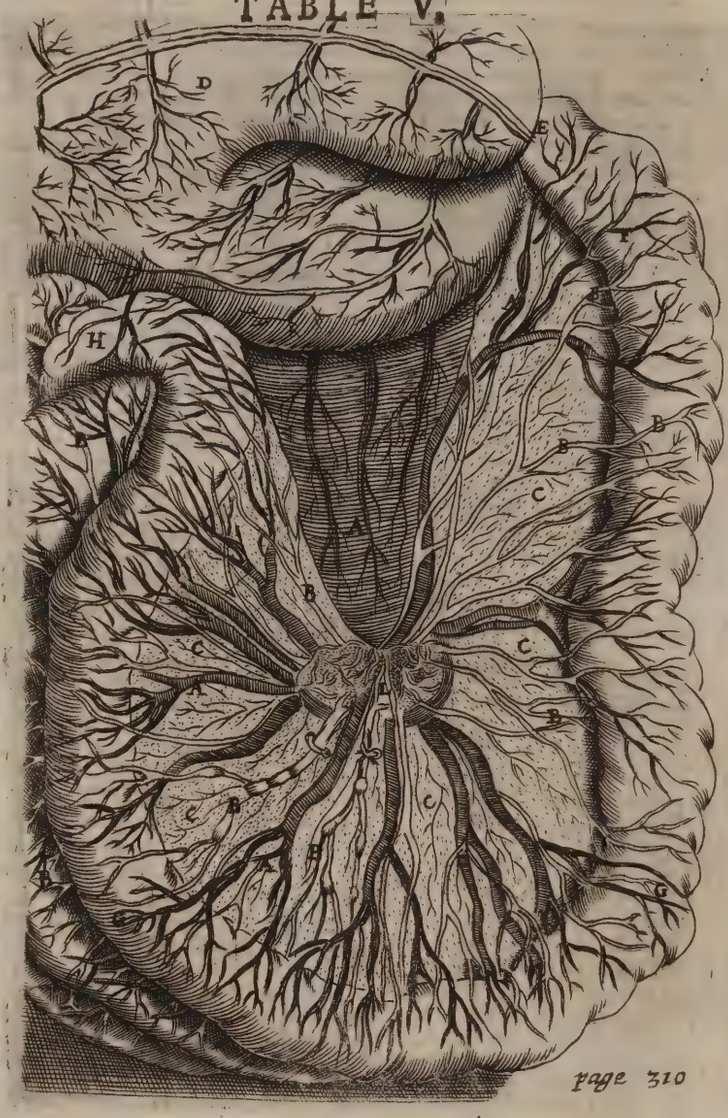
H *The Gut Ileum.*

I. *A Vein and Artery creeping through the bottom of the Stomach.*

K. *Part of the Call.*

L. *The great Kernel in the riſe of the Meſentery which* Aſellius *cals the Pancreas.*

TABLE V.



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Their Uſe. Their *Action* and proper *Uſe* is 1. To deliver up the Chylus to the Liver, not by the Meſaraicks as hath been hitherto believed, by which neither the Chylus aſcends to the Liver, nor the blood deſcends to the Guts, as was ſaid before. Nor let the abundance of the ſaid Meſaraicks trouble us, which the cold and bloodleſs Guts do not need; becauſe doubtleſs they need more of Heat and much nouriſhment, adminiſtred by the abundance of meſaraick Arteries, and therefore plenty of Veins ought to anſwer the plenty of Arteries, that they might carry back the ſuperfluous blood to the Liver.

II To render the Chyle more fit to receive the form of Blood in the Liver. But they are deceived who do aſſigne to them the blood-makeing faculty, for the *Chylus* is not at all changed in colour till it come unto the Liver, where it begins by little and little to grow reddiſh or paleiſh.

III They much conduce to facilitate the Art of Phyſick. For 1 They diſcover a ready way for diſtribution of the Chylus, which has hitherto bin very much controverted, without any fear of a contrary motion or confuſion. 2 They ſhew that the Blood is made in the Liver and its fleſh, and not in the veins. 3 That the ſucking of the Veins is no cauſe of Hunger, becauſe none are carried to the Stomach.

IV They declare the Cauſes of ſome Diſeaſes of the Body which were before obſcure, viz. of the chylous flux of the Guts; of pineing away of the Body, for want of Nouriſhment, by reaſon of the kernels of the Meſentery overcome with ſcirrhous ſwellings, of intermitting Agues quartered in the *Meſaræum*, Hypocondriacal Melancholy &c.

V The learned *Gaſſendus* conceives that by the milkie Veins the white juyce contained in them is carried over the whole Body, to breed Fat; and that the true Chylus is brought the neereſt way by the Porus biliarius, out of the Stomach unto the Liver; But neither of theſe may be granted. Not the former, becauſe of the reaſons brought before, Book the 7 againſt *Folius*, touching the matter of Fat which *Riolanus* approves and commends; nor the latter, becauſe the Chyle would be infected by meeting with bitter Choler, though that renowned man allows in caſe of neceſſity, the Jejunum being obſtructed, it may ſo be done.

And ſo much may ſuffice touching the Hiſtory ſo the Venæ Lacteæ, to which there is hardly any thing remainning to be added, unleſs the cauſe of their ſudden diſappearing, which is ſufficiently controverted. which is not to be imputed to the ſpiritual diſpoſition of the Chylus which ſuddenly vaniſhes away, as *Aſellius* did at firſt beleive, becauſe the Chylus being drawn out of the Veins does keep its colour a very long time, not vaniſhing away, but becoming wateriſh. But to that which did afterward ſeem probable to *Aſellius* viz. the ſtrong drawing of the Liver, in ſo gre t Anxiety of the Aimmal, all this

this may be attributed, by which the spirits being consumed, they need new Blood and Chyle speedily to be digested. And hence a reason may be rendred, why the Venæ lacteæ in a man hang'd at *Amsterdam* cut up by Dr. *Tulpius*, remained visible many daies after; such as have bin divers times seen by *Vestingius* at *Padua*, and *Folius* at *Venice*: For by reason of the pains broke off by choaking, there could be no drawing of the Liver. For whereas in a Girle ten months old, *Vestingus* found these Veins swelling: I ascribe that to a like weakness of the Liver, or the thickness of the milkie humor. I also saw at *Hafnia* the last yeer, the milkey veins in *Sueno Olai* of *Vardberg* (who was immediately choak'd with a peice of neats-tongue, having before eaten and drank plentifully) visible in the Mesentery, because respiration being hind ed by the bit of tongue, and his heart being suffocated, there was no necessity for the Liver to draw any Chylus. But *P. Laurembergius* as a man ignorant of this Anatomy does vainly imagine with himselfe, that these veins do disappear, because of the recourse of the Chylus to the Guts, the Valves being loose and flaggie: for, 1 Do all you can, you shall never bring the Chylus back, in dead bodies into the Guts. 2 If a vein be tied in the middle, so that a passage is left open on both sides, both towards the Liver and the Guts: where it looks to the Liver it is emptie, but it swells exceedingly towards the Guts, and if it be left in that posture for some daies together the Chyle will not slip back into the Guts.

CHAP. IV.
Of the Hæmorrhoid Veins.

The Hæmorrhoid Veins what?

THe *Hæmorrhoidal Veins* are those which are in the Fundament, or *Intestinum rectum*, and are also extrinsecally visible, which in some men at set times do open of their own accord, and void forth dreggie Blood, which evacuation does much conduce to Health.

The Error of other Anatomists.

These Veins are not of one kind, as the Ancients and many later writers have Imagined: But some are termed *internal*, which arise from the *Vena portæ*, others *external*, from the *Cava*, with which the hæmorrhoidal Arteries are associated, through which the Humors to be evacuated, are carryed.

The Ancients knew only the *Internal* ones, as being commended in melancholick and spleenetick diseases: and they may be opened about the fundament, or leeches may be applied to them, whereas otherwise no branches of the Vena portæ which lies concealed within, do go out to the skin, which can be opened.

The Differences between the internal and external Hæmorrhoides.

The internal and external Hæmorrhoid Veins differ one from another.

I In their *Original*. For the *Internal* arises as was said before, From the Vena portæ, and descends along the end of the Colon, under the right gut, the end whereof or Fundament, it circularly embraces with certain final twigs. It arises sometimes from the Ramus splenicus, from whence is the Vas breve. But seldome which *Casserius* once observed, from the Spleen it self. *Vestingus* observed it twice or thrice, and therefore *Robert Flud* is out, who condemns the opening of the Hæmorrhoid Veins, because they void not from the Spleen, but rather from the Mesenterie, to the great damage of the Guts and Stomach.

But the *external* Hæmorrhoides *arise* from the Hypogastrick branch of the Cava.

II By their *Insertion* For the *internal* is inserted into the substance of the Intestinum rectum, which is membranous, and required thick Blood made in the Spleen, and communicated by the Arteria Cœliaca or Splenica.

The external are inserted into the Musculous Substance of the Fundament, which required purer Blood, elaborated in the Heart, and brought hither by the branches of the Arteries.

III In *Number*, the *Internal* is one in number, the *external* is threefold.

IV In the *Quality of the Blood contained.* The Blood of the inner is thick and black, the Blood of the outer is thinner and redder.

V In their *Use* The internal empty the Vena portæ successively, but first the Spleenick Arteries, and help the Obstructions of the Spleen: the external empty the Vena Cava, the Liver by accident, but primarily the great Arterie, and the Heart; yea their evacuation cures diseases springing from Blood, of the Head, Chest, &c. Which *Hippocrates* hints in his *Aphorismes*, and therefore the internal are said to cure the *Cacochymia*, or badness of Humors, the external the *Plethoria* or fullness of good Blood.

VI *In the plentiful profusion of Blood.* The flux of the *internal* ones is not so plentiful; that of the *external* is sometimes so large, that men die by the extremity thereof, or fal into greivous diseases.

VII In the Evacuation of the external ones, there is no *Paine* nor Gripeing of the Belly; and some times also no paine in the Fundament; but in the flux of the *inner* Hæmorrhoides, there is greivous paine.

VIII The *Internal* do alone descend, unaccompanyed with the Arteries, howbeit either the Arteries are hidden, or they depend of Arteries in the upper-more.

The *external* descend with the Arteries to the Muscles of the Fundament, manifestly; and therefore the external are more properly called *Vasa Hæmorrhoidalia*, to include the Arteries with the Veins.

Chap. V. *Of the ascending Trunk of* Vena Cava, *especially of the* Vena sine pari.

The Vena Cava *what?*

VEna Cava called also *Vena magna* and *maxima*, the great vein and the greatest vein, by the Ancients, because of its exceeding largness, and by *Aurelianus*, *Vena crassa* the thick Vein, is the largest Vein in our whole Body, and the Mother of all other Veins which do not proceed from the Vena Portæ; coming out of the bunching or convex side of the Liver, and therefore by *Hippocrates* termed the Liver vein, haveing spread many Veins through the upper part of the Liver, which about the top are collected into one Trunk it is presently divided into the upper or ascendent, and the lower and descendent Trunks.

Its division into great Trunks.

The ascendent Trunk what?

The *Ascendent Trunk* peirces the Midrif, is spread about through the Chest, Neck, Head and Arms. Now it is carried undivided, as far as to the Jugulum. Mean while four branches arise there from.

The Vein of the Midrif pericardium and mediastinum.

1 *Phrenicus* or the Midrif vein, on each side one, whence also branches are sent to the Pericardium and Mediastinum. That Quittor in such as have the *Empyema*, is carried by this Vein to

the

the Kidnies and Bladder *M. A. Severinus* ingeniously proves, because 1. The quittor must needs rest at the bottom of the Midriff. 2. By the motion of the Septum it is easily made thin. 3. By the same motion the mouths of the vessels are opened. which may more truly be said of the Arteries, which carry Blood to the Kidnies by their emulgent Branches, and with the Blood sundry excrements, as quittor, Serum &c.

Afterwards the *Vena cava* ascends by the Septum, and boring its passage through the Pericardium, it goes a little towards the left hand, and insinuates it self into the right Ventricle of the Heart, with a large hole, where it is joyned on all sides to the left Ear-let: and there is made,

2. The *Vena Coronaria*, which is sometimes double, compassing the Basis of the Heart, at the Rise whereof a little *Valve* is placed, not suffering the Blood to return into the Trunk. For it is joyned with a continued passage to the Artery, that it may therefrom receive blood, which is to return to the *Cava*.

Afterwards the ascendent Trunk does at last, bore its way through the Pericardium, and taking the former shape, it had under the Heart, but smaller, thorugh the middle division of the Lungs (no more upon the Vertebra's of the Chest, where now the Gullet and Wesand rest) it ascends to the Jugulum. Mean while there is bred

3. A remarkable *Vein* above the Heart called *Azygos, sine pari*, the Vein without a fellow, because in a Man and a Dog, it is commonly but one, quartering on the one side, without another on the other side. But there are two in some Creatures which chew the cud, as Goats, and in Swine &c. And in the Body of Man I have often seen two, once I found none at all, instead whereof on each side there descended a Branch from the *Vena Subclavia*.

It *arises* from the hinder part of the Cava but more towards the right hand, and descends through the right Cavity of the Chest: but in Sheep contrariwise, it arises from the left side of the *Cava*, and descends through the left. In a Man after its Beginning, which is between the fourth and fist Vertebra of the Chest, it bends a little back towards the right side and outwardly, unto the eighth or ninth Vertebra of the Chest; where it begins to posses the very middle space. Howbeit, I have observed it presently after its rise, to descend right forward, above the middle of the Back-bone, and to send out branches on each side.

This *Truncus sine pari*, for the space of eight lower Ribs, sends out on each hand Intercostal branches, which are sometimes here and there joyned by way of Anastomosis, with the branches of the Thoracica inferior which arises from the Basilica, and with the Intercostal Arteries. And therefore a Vein is not alwaies to be opened in a Pleurisie of the right side, as *Vesalius* would have it.

Anastomosis.

The Error of Vesalius.

Neer the Eighth Rib, it is divided into two Branches.

The one being sometimes the greater, ascends under the Diaphragma to the left side, and is inserted sometimes into the *Cava* above or beneath the Emulgents, sometimes into the Emulgent it self. This way, according to the vulgar Doctrine, pleuritick persons, are many times critically purged by Urine, and void out that way abundance of Quittor: which matter may more truly be said to be purged out by the emulgent Arteries, by mediation of the Heart.

How pleuritick persons are purged by Urine.

The other *on the right hand*, goes to the *Cava* and is joyned thereto, seldom to the Emulgent, sometimes bove, the Emulgent. Often times it is implanted into the last sometimes into the first lumbal Vessel; for which cause, in the beginning of a Pleurisie, the Ham-vein may be opened, to draw away the Blood, which would otherwise ascend out of the Arteries and small Veins, into this Vein.

Why the Ham-vein is profitably opened in a Pleurisie.

And whereas *Hollerius* and *Amatus* dream that this Vein hath *Valves* in its Beginning, it is false. and therefore false it is, that the *Cava* being evacuated, the *Vena sine pari* is not evacuated, because the Regurgitation is hindred by the Valves. *Fallopius* denies them, because he saw both Wind and Blood regurgitate from thence.

The Error of Amatus Lusitanus and Hollerius touching Valves.

4. The *Intercostalis superior*, on each side one, which is sent to the Intervals of the four upper Ribs, when the *Azygos* hath not sent branches to all the Intervals of the Ribs.

Chap. 6. *Of the* Vena subclavia *and its Branches, and the Jugulars.*

THe Branches aforesaid being constituted, the *Cava* ascends to the *Claviculæ*, underpropped with the *Thymus*, where it is commonly thought to be divided, and in many Anatomical Tables is so represented, into four parts, on either side into an upper part and a lower. whence a common Error of Practitioners arises who scrupulously open the Basilica Vein, in parts affected beneath the Neck; the Cephalica in Diseases of the Head. But at the *Claviculæ* or channel-bones the *truncus vena cavæ* is divided not into four *branches* but *two* only, on each side one, the right and left, which are termed *Subclavij* and by some *Axillares*.

The Error of other Anatomists.

An Error of Practitioners in Blood-letting.

Wherefore it matters not in Diseases below the Neck, whether you open the Basilica or Cephalick Vein: for the Trunk of *Vena Cava* is alike emptied, for the *Cephalica* and *Basilica* proceed from one root. The Chyrurgeon ought to cut that which of the two is most apparent.

The most apparent Vein is to be opened.

Howbeit in Diseases of the Head (if the Circulation did not perswade the contrary) the opening of the Cephalick Vein would help a little more, because there is a branch inserted thereinto proceeding from the external jugular; which I have observed more than once in divers Bodies. But the Case is all one, because the Carotick Arteries exclude all this Difference.

From the Subclavian Veins there arise both upper and lower Veins; and the lower both before and after division: before the division, four.

1. The *Mammaria* (whose original doth notwithstanding many times vary) on each side one, sometimes without a fellow, descending into the Duggs, of which I have made frequent mention. This by way of Anastomosis, is sometimes joyned to the Epigastrica under the right Muscles of the Abdomen.

2. The *Mediastina* which comes to the Mediastinum and the Thymus.

3. *Cervicalis* for the Muscles which lie upon the Vertebra's and for the Marrow of the Neck.

4. *Musculæ inferior*, for the lower Muscles of the Neck and the upper of the Breast. and this also arises sometimes, from the external Jugular.

The *Subclavian* Trunk, being gone out of the Cavity of the Chest, is then properly termed *Axillaris* and the *Scapularis duplex* doth from hence arise, for the external and internal muscles of the *Scapula*, and for the kernels of the Arm-pits. Afterwards the *Axillaris* is divided into the upper branch or *Vena Cephalica*, and the lower or

Basilica

The FIGURE Explained.

This TABLE propounds the chief distribution of *Vena cava* through the whole Body.

A. *The Trunk of Vena Cava below the Heart.*
B. *Its Trunk above the Heart.*
C. *An hole whereby it gapes into the Heart.*
DD. *The Subclavian Branches.*
ee. *The mammary Veins.*
f. *The Vena Mediastina.*
gg. *The Venæ cervicales.*
hh. *The Venæ Vertebrales.*
iiii. *The Jugulares externæ.*
kkkk. *The Jugulares internæ.*
Llll. *The Vena Azygos or sine Pari.*
mm. *The Intercostalis superior.*
nn. *The Rami phrenici.*
ooooo. *The Branches of Cava through the Liver.*
p. *The Scapularis interna.*
q. *The Scapularis externa.*
r. *The Thoracica superior.*
s. *The Thoracica inferior.*
T. *The Cephalica.*
V. *Its external Branch.*
X. *Its internal branch which in part constitutes the Mediana.*
ZZ. *The Basilica Vein.*
αα. *Its first Bough.*
ββ. *The external Branch of the second Bough.*
δδ. *The internal branch of the second Bough.*
θθ. *The third Bough constituting the other part of the Mediana.*
xx. *The Salvatella.*

These following Characters design the lower Veins.

AA. *The Emulgent Veins.*
BBBB. *The Spermatick Veins.*
ccc. *The Veins of the Kidney-kernels.*
dddd. *The Lumbal Veins.*
EE. *The Rami Iliaci.*
ff. *The Muscula superior.*
gg. *The Sacra.*
HH. *The Ramus Iliacus externus.*
II. *The Ramus Iliacus Internus.*
kk. *The Muscula media.*
LL. *The Venæ Epigastricæ.*
mmmm. *The Hypogastricæ Venæ.*
nn. *The Muscula inferior.*
oo. *The Vena pudenda.*
PP. *The Crural Branch.*
Qqqq. *The Vena Saphæna.*
rr. *The Ischias minor.*
ssss. *The Musculæ.*
ttt. *The Poplitæa.*
uu. *The Suralis.*
xx. *The Ischias major.*

Basilica, as shal be said in the following Chapter touching Veins of the Head.

From the Axillary after its division from the Trunk of the *Basilica* arise two Veins.

1. *Thoracica superior* spent into the Muscles spred upon the Chest, and into Womens Dugs.
2. *Inferior* which sometimes grows out of

Anastomoses. the superior creeping all over the side of the Chest, whose branches are joyned by way of Anastomosis with the Branches of *Vena sine pari* which proceed out of the Chest.

From the upper part of the subclavian trunk, there first arises *musculi superior*, spread out near the jugularis externa, into the skin, and muscles of the hinder-part of the Neck. And afterwards,

Jugular veins why so called. The *jugular* Veins, so called, because they ascend in the Jugulum at the sides of the Neck; and they are *internal* or *external*.

External, which sometimes, either in its original, or in the middle of its passage, is twofold, creeping upwards under the Skin, and provides for the external parts of the Head, Face, Neck, and Fauces. For under the root of the Ear, it is *divided* into the internal and external *branch*. The *internal* goes unto the muscles of the Mouth, Fauces, Hyoides, &c. The *exterior* being under the Ear propped with kernels, is divided into two parts; one part is carried into the fore-parts of the Face, the Nose and Cheeks, and in the middle of the Forehead being joyned with a Branch of the other side, it makes the Vein of the Forehead which is usually opened. The other is carried through the sides, the Temples, and the Occiput. This the wise *Severinus* opens with very great successe, in the Head-ach, Hoarsnes, Shortnes of Breath, Pleurisie, pain of the Spleen, Tetters, Squinzy, and which I was present and saw, in Varices of the Face. Mean while these branches are variously mingled in the Head and the Crown of the Head.

The *internal* Jugular in men is the greater, because of their abundance of Brains, but in *Beasts* it is contrarywise Tis called *Apoplecta*, and does ascend to the side of the *Trachea*, to which it sends branches. Reaching to the *Basis* of the Skull in its hinder-part, it is divided into two branches. The one which is the greater, is carryed backwards with the lesser branch of the Carotick Arterie, through the hole of the *Os Occipitis*, which is made for the sixt Pare of Nerves, and enters into the cavity of the *dura mater*. The other being lesser, entring at the hole of the third and fourth pare, is spent into the *Dura Mater*.

Chap. 7. *Of the Veins of the Arms and Hands.*

THe *axillary Vein* as we have observed in the foregoing Chapter, is divided at the beginning of the Arm, into two remarkeable Branches: the upper and lesser, or the Vena *Cephalica*, and the lower and greater or *Basilica*.

The upper is called Vena *humeraria Cubiti inferior*, *Cephalica* or Capitalis, the Head-vein, because it is wont to be opened in Diseases of the Head, by the Ancients, and by later Surgeons also either out of Ignorance or Superstition.

In *Brutes* it *arises* from the external Jugular, in Men allwaies from the axillary, yet so that from the external Jugular a short twig may be inserted into the Cephalica.

It is carried in the Surface of the Body, between the fleshy Membrane and Coat of the Muscles.

Its *external branch* termed *Funis Brachii*, at the middle of the wrist, in the lower part, is joyned to a branch of the Basilica, and afterwards arising into the outer side of the wrist, passing along between the ring finger and the little finger, it is called *Salvatella*, which is that which the *Arabians* term *Siels*, who as others at this day, commend the opening thereof in the left hand, against melancholick diseases, acute Fevers, and tertian Agues, but in vain, and upon no ground at all. As *Joh. Bapt. Sylvaticus* has proved in a distinct Treatise, and *Severinus* lately, whatever *Spigelius* may dispute touching Anastomoses of the Arteries, in the extream parts, wherewith the Spleen abounds: For the Spleen is more remote, and any other part may be as wel opened, for there are Anastomoses in a manner every where.

They make that the *inner branch* of the *Cephalica* which constitutes the *mediana*.

Basilica by some call'd *Cubiti interior*, *Epatica*, *Jecoraria*, &c. the Liver vein, because in diseases of the Liver it is usually opened: but in the left side tis termed *Lienaris* the Spleen vein because the opening thereof is commended in Diseases of the Spleen, upon no ground at all.

A Caution in opening the Basilica or Liver vein. But let Surgeons take heed when they open this Vein, least they wound a Nerve of the third and fourth pare, which lies neer the same, whence follows great pain, a Feaver, Convulsion, and Death. Also Arteries lie beneath the same, which being hurt, causes an *Aneurisma* and effusion of Blood.

This Vein is divided into more Boughes then the Head vein. Under the tendon of the pectoral muscle it is divided into three Branches.

I The first goes along with that Nerve of the Arme, which they cal the fourth.

II The next is termed *Medius* and *Profundus*, beneath the Elboe Joynt divided into an external and an internal branch, separated but a little way one from another. The former provides for the Thumb, Forefinger, and Middlefinger; as also for the external muscles of the Hand. The latter being stretched along the middle bone of the Cubit, servs the Middlefinger, the Rinfinger, and the little finger, as also the internal Muscles of the Hand.

III The Subcutaneus is divided at the inner swelling of the Arm, is divided into a foremore and hindermore Branch: The latter descends under the Ulna by the little finger, where it is joyned to a Branch of the Cephalica. The former as it passes along the Cubit, produces another remarkeable Vein, which proceeds sometimes directly, otherwhiles with various turnings unto the wrist. And then as it is carried along the Cubit, with the inner Branch of the Cephalica, it makes a common Vein which is called

Mediana by *Avicen nigra*, tis cald the mediana or middle Vein because of its Situation in the midst of the Arm. It is frequently opened without danger, because there is no Nerve beneath it, but only the Tendon of a Muscle. From this or rather from that part of the Basilica, whence this arises, a branch is sent forth, which being divided above the *Radius*, produces an exteriour branch, between the Thumb and the Forefinger, which some cal *Cephalica*, others *Occularis*, and some again as *Mundinus*, *Salvatella*, and another more inward, betwixt the middle finger, and the Ring finger, which some as *Rhasis* count the *Siels* or rather *Seilem* of *Avicenna*.

The Variation of the Veins of the Arm. But touching the Distribution of all these Veins it is to be observed, that they differ in several Bodies, and are seldome in one man, as they are in another; yea the right side of the same man does rarely agree with the left; and in like manner they varie in Magnitude, in several persons.

CHAP.

CHAP. VIII.
Of the Trunk of Vena cava *descending as far as to the Thighes.*

THe lower Trunk of *Vena Cava* proceeding out of the Liver, called the descendent Trunk, is more narrow then the upper or ascendent (which serves very many parts) and proceeds undivided accompanied with with a great Arterie, as far as to the fourth Vertebra of the Loyns. Mean while it sends forth these folowing Boughes.

I The *Venæ adiposæ* which serves the Coat of the Kidneyes and their Fat, the left of which, is commonly higher then the right.

II The *emulgent* Veins, descending to the Kidneyes by a short and crooked passage, sometimes with a threefold Rise, bringing back the wheyish Blood being purified from the Kidnyes into the Vena Cava.

3. The *Spermatick* Veins of which in the first Book.

4. The *Lumbaces* or Loyn-veins, somtimes two, somtimes three, which are carried betwixt the four Vertebra's of the Loyns. From these *some* write that they have observed two Veins ascending, within the Vertebra's, on each hand to the side of the spinal marrow in the Brain, which makes them conjecture, that a portion of the seminary matter is brought from the Brain.

These being thus constituted, the *Trunk* going towards *Os sacrum*, at the fourth Vertebra of the Loyns, it goes under the Aorta, which before was under it, and is *divided* into two equal *Branches*, termed *Rami Ilij* or *Iliaci*, because they go over the *Os Ilij* and *Os pubis* unto the Thighes.

About the division it self, there arise two Veins; the *Musçula superior* serving the Peritonæum and the Muscles of the Loyns and Belly, and the *Sacra*, somtimes single, otherwhiles double, for the Marrow of *Os sacrum*.

Afterward the *Ramus Iliacus* is forked out on each side into the external greater, and the internal lesser.

From the inner two Veins sprout; the *Musçula media* without, serving the Muscles seated on the outside of the Hip, and the skin of the Buttocks; and the *Hypogastrica* which is remarkable, somtimes double, serving very many parts of the *Hypogastrium*, as the Muscles of *Intestinum rectum*, whence are the *Hæmorhoides externæ*; the Bladder and its Neck, the Yard, the lower side and neck of the womb. whence are those Veins by which menstrual Blood is many times thought to be purged in Virgins and Women with Child; which nevertheless seldom happens, when the *Venæ Hypogastricæ* do cumulate thick Blood, and send it not back unto the Trunck, then they may be opened, but otherwise, they are indeed suppressed; but they ascend unto the Heart by the *Vena Cava*, and cause palpitations and other symptomes. But when they are right, the Courses are naturally voided by the Arteries, which appears by their florid color, and the common Office of the Arteries, which is to carry unto the parts of body. *Walæus* proves this also by other tokens in his Epistles. This branch when it is joyned with the crural branch internal, doth cease.

From the outer, three: two before it goes out of the Peritoneum, and one afterward: the first is the *Epigastriæa* (which seldom arises from the crural) to serve the Peritoneum and Muscles of the Belly; the chief part ascends, under the right Muscles to the Mammariæ, to which they are often joyned about the Navil.

2. The *Vena pudendâ*, which serves the Privy Parts in Men and Women; it goes athwart to the middle of *Os pubis*.

3. *Musçula inferior*, going over the side of the Hip-joynt, to serve the Muscles and skin of that part.

Afterwards its Branches are termed Crurals.

Chap. 9. *Of the Crural Veins.*

THe *Venæ Crurales*, as also the Arteries and Nerves passing along, are in the bending of the Thigh interwoven with frequent kernels, for firmness sake. Afterwards there arise from the crural Vein six branches.

1. *Saphæda* (so cal'd because of its apparency more than other foot-Veins) or *Vena mæleoli* the *Anckle-vein*, is long and remarkable, it is carried along in the Inside of the Thigh, with a Nerve stretched by it, between the Skin and *Membrana Carnosa* to the Knee, and along the inner part of the Leg, it goes to the inner Anckle. And it is variously distributed into the upper parts of the Foot, towards the Toes, especially the great Toe. This is opened about the Ankle, in Diseases of the Womb, especially when the Courses are stopt, and in the Gonorrhæa to evacuate or revell the Blood which otherwise would ascend too plentifully unto the Womb and Genitals. Now it must be opened where it is most apparent, whether it be on the Back or side of the Foot.

2. *Ischias minor* is opposite to the former. for it is a short outer branch, springing from the crural: it is carried outwardly and athwart into the skin of the Hip, and the Muscles of that place.

3. *Musçula*, arises from a Trunk, which lies hid among the Muscles: it is a double and remarkable Branch, distributed among the Muscles seated in the Thigh.

4. *Poplitea* the Ham-vein, is made of a double Crural branch mingled together, and runs streight along under the Skin, behind, through the midst of the bending of the Ham, as far as to the Heel, somtimes to the Skin of the Outer Ankle. This Vein is commonly supposed to have been frequently open'd by the Ancients, under the Knee, and *Paulus Magnus* a Chyrurgeon of *Rome*, did once open it. But because it lies exceeding deep, and cannot be seen, we must suppose it cannot be opened; and perhaps this is not the *Vena poplitea* of the Ancients, especially seeing *Galen* is exceeding various in his description thereof, and calls it somtimes the Vein in the Ham, somtimes about the Ham, somtimes at the Knee, otherwhiles under the Knee; peradventure he meant the Ankle-vein, which descends to the inner bunching of the Leg, and is indeed conspicuous enough under the Knee.

5. Is cal'd *Suralis*, which is a great Vein; and is divided into the external and lesser, and the internal and greater branch, and each of them again into exterior and interior. It is distributed amongst the Muscles of the calf of the Leg. On the back of the Foot, being mixed with the branches of the *Poplitea*, it makes that same various texture of Veins, which is apparent under the Skin.

6. *Ischias Major* gives a part to the Muscles of the Calf, and then spends it self into ten branches, bestowing a couple upon each Toe.

Touching all these it is to be noted: 1. That all these branches, do send divers tigs outwards to the Skin, which are termed Skin-veins.

2. That all these branches are diversly disposed in different men, as was said in the Arms; nor is there alwaies the same carriage of Veins, in both the Legs of the same person.

3. That there is also no great choyce to be made in opening the Veins of the Feet; seeing they are all derived from one Trunk, and the Blood ascends from the extream parts and Arteries.

THE

THE SECOND MANUAL Of the Arteries, Answering to the SECOND BOOK Touching the Middle Cavity or Cheſt.

CHAP. I.
Of the Arteries in General.

The name Artery.

ARteria an Artery ſo called from containing and preſerving Air or ſpirit; was by the Antients *Hippocrates*, *Plato* and *Ariſtotle* the name of the Wind-pipe, which alſo *Hippocrates* calls *Arteria magna*. *Galen* makes a diſtinction and cals the Wind-pipe *Aſpera Arteria* the rough Artery, and thoſe whereof we are now to treat *Arteriæ leves* the ſmooth Arteries, which *Hippocrates* cals *Arterias parvas*, *Ariſtotle* ſomtimes *Venam Aortam*, otherwhiles ſimply *Aorta*.

What an Artery is.

Now an *Artery* properly ſo called, is a common Organ, round, long, hollow like a pipe; conſiſting of a double Coat, proceeding from the Heart, fit to carry Blood and vital ſpirits to all parts.

The *Efficient* is the proper Artery-making faculty, which may be called *Arteropoietice*.

The *matter* whereof it is made, is a clammy and cold part of the ſeed, according to *Hippocrates*. And this is the Beginning of its Generation.

The Beginning of its Diſpenſation, is not the Brain, as *Pelops Galen*'s Maſter would have it, but the Heart by the Conſent of all Philoſophers and Phyſitians. And indeed the Arteries proceed out of the left Chamber or Ventricle of the Heart, not the middlemoſt, which *Ariſtotle* feigns to himſelf, and would have the Aorta to proceed therefrom. And therefore the *Arteria magna* proceeds from the Heart, as alſo the *Veneſa Arteria*, and the *Vena Arterioſa*, but theſe out of the right Ventricle; of which we have ſpoken already in the *ſecond Book*.

The End of the Arteries.

Their *End* or Uſe is, I. Inaſmuch as they are Conduit-pipes, they carry the Blood and vital or arterial ſpirit made in the Heart (for Spirit alone without Blood is not contained in the Arteries) to all parts of the Body. 1. To communicate life or vital faculty, that the vital ſpirit implanted in the parts, and their Native heat may be ſuſtained and cheriſhed. 2. That animal ſpirit may be bred, in the noble Ventricle of the Marrow. 3. For the nouriſhment of all the parts, which are nouriſhed by theſe only and their Blood and not by the venal Blood or Veins. 4. To carry the Excrements of the Body and the Blood therewith mingled, either to the outer parts of the body to the Kidnies, or the Meſentery, or the Womb, or the hæmorrhoid Veins, &c.

Why the Arteries pulſe.

II. Inaſmuch as they are moved and pulſe perpetually; they afford this benefit. 1. That the heat of the parts is fanned, cooled and tempered, and ſo a ſymmetrie or due proportion of Heat is preſerved. which is cauſed, not ſo much by the Airs being drawn in, when the Artery is widened, to avoid Vacuum, as by the arterial Blood continually flowing in, impregnated with Air. 2. That this nouriſhing arterial Blood, may be continually poured into the ſmalleſt Arteries, and from thence into the parts of the Body. For *in the firſt place*, the Heart by continuall pulſing, drives the Blood into the greater Arteries, which becauſe they cannot let it return becauſe of the Valves, and are too ſtrong to break, it muſt needs be driven to to the very ſmalleſt Arteries and the parts of the Body. And thoſe parts not being nouriſhed with all that is forced in, do ſend back that which is ſuperfluous into the Veins, that ſo it may be circulated. *Moreover*, an Arterie being bound in any part of the Body, it is filled towards the Heart, otherwiſe than the Veins; contrariwiſe towards the ſmalleſt Arteries and the parts it is emptied. *Thirdly*, In Blood-letting, the Arm being indifferently

rently hard bound and the pulse remaining, the Arm is filled, and a Vein being opened below the band, Blood plentifully issues, which because it cannot come out of the Veins which lying higher are stopped by the Ligature, it must needs be brought from the Arteries beneath. *Fourthly*, in live-Creatures dissected, this Tumor of the Arteries is observed neer their Original, and a lankness towards the extream parts of Body, into which they go; and when they are opened, there is a mighty flux of blood, on this side the band, none beyond it. *Lastly*, the same is to be seen by an Aneurisma. 3. Least the Blood of the Veins to which they are joyned, should be stil, and putrifie like standing waters, and that the Heart may not be destitute of Blood in its continual expulsion, by the driving Arteries it is continually filled again through the Veins.

The Pulse how caused.

This Motion of the Arteries called the *Pulse*, is caused, either by the faculty alone, whether seated in the Arteries themselves, as *Praxagoras* would have it, or flowing from the Heart by the coats of the Arteries, as *Galen* and infinite Physitians after him have taught, especially by reason of a little Reed put into the Arteries, under which they are not mov'd, by reason of the Intercepton of their coat, til it be taken away. again, because as the Heart is contracted and widened, so are the Arteries, as appears by laying one hand to the region of the Heart, and the other to the Wrist, and by wounds in the Heart and Arteries: or by the *Blood* either boyling according to *Aristotle*, or rarefied according to *Des Cartes*, or meerly distending as *Harvey* hath proved: or from both the Blood filling, and the faculty directing, which is my opinion. For that the Arteries are moved and distended by the *Blood*, I prove. 1. The Heart by its perpetual pulsing, expels great store of Blood, as I have demostrated in my Chapter of the Heart. 2. That the same Blood doth fill and move the Arteries, the Artery it self shews, being laid bare, into which at every pulse, you shall feel with your fingers the Blood driven in to flow down, with which it is dilated. 3. When an Artery is opened, Blood leaps out, at every pulse, as out of the Heart. 4. *Harvey* saw a portion of the descendent Artery with two crural branches a span long taken out of the Body of a Gentleman, which was turned into a fistulous hollow bone, and nevertheless the Blood which when he was living, descended through the the Cavity thereof into his Legs, did move the Arteries beneath, by its impulse. The same hath been observed by others in the *Arteria Aorta* 5. In an Aneurisma the flesh is manifestly seen to pulse, as formerly the Artery being found was wont to do by the afflux of Blood. 6. The waving, Worm-creeping pulse, do argue the same, in the judgment of *Walæus*. 7. *Harvey* gives us another rare experiment, made with the Guts of a Dog, Wolf or other Creature dried, blown up and filled with Water. For if we smite one end with our Finger, and lay our fingers to the other end, we may cleerly perceive every stroak, and the difference of the motion. Howbeit I conceive the faculty ought to be joyned hereto, communicated to the Coats from the Heart, by help whereof, they are contracted and widned; because, 1. Otherwise the Flux of the Blood would be inordinate, and the pulse alwaies unequal. 2. All the Arteries are dilated or contracted in one moment, but the Blood alone fils the Arteries successively and moves them part after part. Indeed, Gloves being blown into, all the fingers are puffed up at once, which *Harvey* objects, and in a Basin the blow and motion are at once in both ends: but corporeal blood is of another Nature, which cannot be moved like species or Winds. 3. The Faculties or Irradiation of vital light, may run through all parts in the twinkling of an Eye, like the Light of the Sun. See more of this in the Chapter of the Heart. 4. Hence within *Galen* his Reed the Artery is obscurely moved, because the swift motion of the Blood ceases when the Faculty is hindred. Howbeit, *Harvey* and *Walæus* argue differently about this difficult Experiment.

Whether the Arteries are dilated together with the Heart or no.

Now all the Arteries are widened when the Heart is contracted, and contracted when the Heart is widened, which is certain from the dissection of an Artery and the Heart, and from Ligatures, nor was it so long ago unknown to *Erasistratus*, and reason confirmes the same, because when the Heart expels, then are the the Arteries filled with its Blood. Yet have they not contrary pulses, as we find by laying our hand to the wrist and the Region of the Heart, at one and the same time, for the pulse of the Heart is perceived by us in its Systole, but that of the Arteries in the Diastole, when they are filled, because the two motions, are at one and the same time. The smallest *capillary* Arteries are not perceived to pulse, because there is not so much force in them, and therefore we can hardly discern them from the Veins, also they have thin Coats, so that the Blood is seen through them, as through the Veins.

The *Form* is apparent from the Accidents; howbeit the form of an Arterie is the Substancial Soul, as it is of the whole Body besides.

Its *Situation* is deep, allwaies under the Veins, that they might be more safe, and that not only in the external, but the internal parts also, if you except the Belly, a little below the Kidneies: For after that the Vena Cava and the Aorta, descending from the *Diaphragma*, have passed the Region of the Kidneies, the Cava hides it self under the Aorta through all that region, til they pass out of the Abdomen; for then the Arterie does again side it selfe under the Cava. The Cause whereof *Plempius* conceives to be this; that otherwise there would have bin danger, least the bending of the Body often happening in that place, the Vena cava having but a single Coat, would have resisted the said motion.

Its Magnitude.

Its *Magnitude* is sufficiently great, but the descending part of the Arterie is greater, the ascendent lesser, because the Number of the internal parts is greater then of the external.

The *Number* of the Arteries is fewer then of the Veins, because the passage of the Blood is quick through the Arteries, slow through the Veins, and therefore there are many receptacles provided for that Blood which is collected by certain pulses. Yet there are more Arteries then we think, or can be discerned by us, because the capillary Arteries are exceeding like to Veins.

Their *Shape* is like a Pipe or Channel, smooth, round, and long.

As to their *Passages*. Some Arteries are terminated into the Guts, by which expulsion of Excrements is caused; some have their mouths terminated into the Skin, through which the external air is attracted (in Transpiration which is performed also by the Veins) and sooty steams expelled. *Platerus* denies that they are inserted into the Bones, but *Spigelius* observed at *Padua*, in a great corruption of the *Os Tibiæ*, that the substance of the Bone was bored through by an Arterie. which perhaps *Aristotle* had likewise seen, because he sayes that Arteries end into a solid Substance.

Whether the Arteries do feel.

They are compassed (like the Veins) sometimes with a membrane thick and common, from the Neighbouring parts, when they are without the Bowels and the Muscles; and such Arteries as have a membrane joyned to them with Nerves in it, do feel; whence *Galen* said the Pulse was inflamed, also that an Arterie did feel, and was pained, which one at *Padua* found in his inner parts, who dying with a mighty pain in his Loyns, Stones like a Mans Nailes were found in his Lumbal Arteries. But other Arteries are without Sense.

Their Substance.

The *Substance* of the Arteries is membranous, so that they may be distended and compressed more then the Veins. *Fallopius* thought

their Substance to be gristly, because he observed that it did degene.ate into a boney nature; which also *Veslingus*, saw, as well as *Harvey*, in the great Arterie above the Valves, near the Heart of an old Man. But that many things are changed into a boney substance, which were not grisley *Columbus* teaches in the *septum Cordis*. Now an Arterie consists of two peculiar *Coats*.

How many Coats an Arterie hath.

The *Exterior* is thin, soft, rare, as the Coat of a Vein is.

The *interior* is compact, hard, and very thick, viz. five times thicker then the Coat of the Veins: And therefore *Herophilus* said, that the Arteries were six times thicker then the Veins, for this Cause, that they might be strong in their perpetual motion, and that their thin Blood should not soon vanish and fly away, being spirituous and vaporous. And therefore in the opening of an Arterie, the incision must be made deep, with a broad and sharp Lancet, because of the deep Situation of the Arterie, and thickness of the Skin. The opening of an Arterie is allowed of by these ancients *Oribasius*, *Ægineta*, *Aetius*, *Actuarius*, *Aurelianus*, *Abensina*. With good success *Galen* practised it, in a disease of the Eyes proceeding from hot Blood, ful of vapors, and in pains of the Hips. *Panarolus* at *Rome* uses the same kind of remedie in a Phrenzie, and *Alpinus* writes that it is frequent in *Ægipt*, which *Paræus* did likewise exercise in *France*, *M. Aurelius Severinus* at *Naples*, and *Paulus Moth* with us, excellent Physitians and Surgeons, do happily open them, to the great good of their Patients, especially in diseases of the Head; in which nevertheless, the opening of an Arterie may seem useless, because 1 Vaporous and hot Blood is as well carried by the inner carotick Arteries unto the Brain, from the Basis to the *plexus retiformis*, as wel as by the external ones, which are opened. 2 The same Blood returnes through the jugular Veins, according to the sure Laws of Circulation. But seeing it did certainly profit the Patients, I conceive it was practised rather by way of preservation, then of Cure. For the antecedent cause being somewhat evacuated by the outer Arteries, the conjunct cause is easily extruded by the jugular Veins. More over, some external Vein or Arterie may be obstructed, so that neither the latter can send, nor the former receive, unless they be opened.

Whether an Artery may be opened, and how.

Galen ads a third Coat, in their inner Surface, like a Cobweb for Thinness, appearing in great Arteries about the Original.

Chap. 2. *Of the ascendent Trunk of the great Arterie.*

THe distribution of the Arteries which alwaies in a manner, accompany the Veins, wil be more easy and short; because the dessemination of the Veins is already understood from what has bin said before.

The *Arteria magna* or *crassa*, the great or thick Artery the mother of the other Arteries, comes out of the left Ventricle of the Heart with a gapeing Orifice or vvide mouth; where within the *Pericardium* or Heart-Bag, it breeds from it self the Arteria

Coronaria, compassing the Basis of the Heart, sometimes single, sometimes double. afterward, going out of the Heart-bag, tis divided into the lesser Trunk ascending, and the greater Trunk descending.

The *lesser* and *upper Trunk* resting upon the Wesand, does provide for all parts quartered above the Heart: and is divided into the *Subclavius Ramus dexter*, which is higher and much the larger, and the *sinister*, rising more low and going obliquely to the Arm.

Afterward the whole Trunk sustained by the Thymus, divides it self into two *Carotides* or Sleep-arteries unequal, which go right upwards.

The *Arteriæ subclaviæ* before they go out of the Chest (for then they are termed *Axillares* when they are out) from their lower part, do produce the *Intercostales superiores* to the Intervals of three or four of the upper Ribs; from their upper part. 1. The *Mammariæ*. 2. The *Cervicales*. 3. The *Musculæ*.

From the *Axillaris* before it comes to the Arm, in the lower part, doth arise the *Thoracica superior*, *Thoracica inferior*, and *Scapularis*: in the upper part, the *Humeraria*. The remainder, goes from the Axillary on each side to the Arm.

CHAP. III. *Of the Arteria Carotides.*

THe *Arteriæ Carotides* do ascend upwards right to the Head by the sides of the Wesand, being knit unto the internal Jugulars: for the internal Veins do not accompany the Arteries. When they come to the Fauces, before they enter the Skul, they give branches to the Larynx and the Tongue: and then a division is made into the outer and inner branch.

The *outer* being the *smaller*, furnishes the Cheeks and Muscles of the Face; and then at the root of the Ears, 'tis divided into two branches; the *one* is sent to the hinder parts of the Ear, whence arise two branches entring the lower Jaw, to furnish the Lip, and the roots of all the lower Teeth: the other goes to the Temples, the Forehead, and the Muscles of the Face.

The *inner* at the saddle of *Os Sphænodes* under the *dura mater*, makes the *Rete mirabile*, and then passes through the *dura mater*, and sends forth two branches. 1. The *lesser* with the Nerve optick to the Eyes. 2. The *greater* ascending to to the side of the *Glandula pituitaria*, and distributed through the *pia mater* and the substance of the Brain.

Chap. 4. *Of the Arteries of the whole Hand.*

THe *Axillary Arterie*, is carried along through the Arm, descending between the Muscles, with a Vein and Nerve of the Arm which they count to be the fourth.

Under the bending of the Elbow, it is divided into two fair branches; the upper and the lower.

The *upper* goes right on through the middle to the Wrist, where Physitians feel the Pulse; afterward proceeding under the ring-shap'd Ligament, it bestows branches upon the Thumb, Fore-finger, and Middle-finger.

The *lower* running through the Ulna to the Wrist; furnishes the Mid-finger Ring-finger and little finger: and so it proceeds to the Wrist, whence we feel the motion of the Pulse beneath, especially in lean persons, or such as have a great Pulse. But we better perceive the pulsing of the former branch, because it is less obscured and hid by Tendons.

CHAP.

The FIGURE Explained.

This TABLE presents the distribution of the *Arteria Magna* or *Aorta*, through the whole Body.

A. *The Beginning of the Arteria magna arising out of the Heart.*
aa. *Its Trunk ascending, from whence arise*
CC. *The Arteriæ Subclaviæ, and from these*
dd. *The Arteriæ carotides, which afterwards produce*
ee. *The Ramus exterior and*
ff. *The Ramus interior.*
gg. *The Arteriæ Vertebrales or Cervicales.*
hh. *The Arteriæ Musculæ.*
ii. *The Arteriæ Mammariæ.*
kk. *The upper intercostal Arteries.*
ll. *The Scapularis interna.*
mm. *Scapularis externa.*
nn. *Thoracica superior.*
oo. *Thoracica inferior.*
pp. *The Ramus axillaris.*
Qq *Its upper branch dispersed through the Arm to the Wrist.*
Rr. *Its inferior branch going also to the Hand.*

These following Characters denote the Arteries which spring from the descendent Trunk.

B. *The Trunk of the Artery descending.*
aaaa. *The lower Intercostal Arteries.*
bb. *The Phrenicæ Arteriæ.*
C. *The Arteria Cæliaca.*
d. *The right branch thereof.*
e. *Its left branch or Arteria Splenica, sprinkled with very small twigs through the Spleen.*
f. *The Arteria Gastrica dextra.*
g. *The Arteria Gastrepiploica.*
h. *The Arteria Epiploica.*
kk. *The Arteria Mesenterica superior.*
ll. *The emulgent Arteries.*
mm. *The Spermatick Arteries.*
mmm. *The Arteriæ Lumbares.*
oo. *The Mesenterica inferior.*
pp. *The Rami Iliaci.*
Qq. *The Arteria Iliaca externa.*
Rr. *The Iliaca interna.*
S. *The Arteria Sacra.*
tt. *Arteriæ Hypogastricæ going to the Arse-gut and the Privities.*
uu. *The Hypogastricæ which go to the Womb.*
XX. *The Umbilical Arteries.*
ZZ. *The Arteria Epigastricæ.*
ΔΔ. *The Arteria Cruralis.*
αα. *The Arteria pudenda.*
ββ. *The Musculæ inferior.*
εε. *The Arteria Musculæ, Cruralis, externæ.*
ηη. *The Musculæ Cruralis interna.*
θθ. *The Poplitæus Ramus.*
κκ. *The Ramus Suralis.*
λλ. *Branches spent upon the Foot and its Toes.*

CHAP. V.

Of the descending Trunk of the great Arterie.

THe Trunk of the *Aorta* or great Arterie *descending* is greater, because it sends out branches from it self, into the middle and lower belly, as also into the Thighes.

In the *Chest* or middle Bellie, two Arteries proceed from the greater Trunk.

I The *Intercostales inferiores* which go unto the Intervalls of eight Ribs, and the neighbouring Muscles. For it seldom happens, that the Vein sine pari, has to accompany it an Arterie sine pari, arising from the Trunk. By these intercostals if we beleive *Spigelius*, quittor and water collected in the Chest, are received into the great Arterie, and thence by the emulgent Veins carried into the Bladder. which has also reason to back it, because the congested matter is more easily hurried through the Arteries, and the way is shorter. I add that quittor more readily follows the natural motion of the Arterial Blood then of the venal.

II. The *Phrenica* to serve the Midriff and Pericardium, or Heart-bag.

The rest of the Trunk peirces through the Clift of the Septum, and spreads branches through the lower Belly, some of which accompany the branches of vena portæ, others the Branches of Vena Cava. Those which accompany the Branches of vena portæ are three;

Cœliaca Arteria, Mesenterica Superior & Inferior.

The *Cœliaca*, so called because it sends many branches unto the Stomach, proceeds foreward from the Aorta, being under propped by the Call, and is divided into the *Ramus dexter* which is the smaller, and the *Sinister Ramus* which is the larger, which under the hinder region of the Stomach, are knit to the Vena Portæ in the Pancreas.

The *Dexter* ascending to the Cavity of the Liver, and proceeding a little forwards, on the higher side produces *Gastrica dextra*, and the *Cysticæ gemellæ*; from its lower part, *Epiploë dextra*, *Intestinalis*, and *Gastroepiploïs dextra*, in imitation of the *Vena portæ*. therefore let what was said there, be here repeated. The Remainder from the *Ramus dexter* goes into the hollow surface of the Liver.

The *Sinister* or *Arteria Splenica*, is greater than the *Dexter*, least it should be easily obstructed by thick juyces, and that it may pour sufficient vital blood, into the Spleen. This Artery drawn out into the *Vena Splenica*, by a bending and crooked Course goes to the Spleen, and then spreads branches after the same manner as the *Vena Splenica*.

The *Mesenterica superior* is distributed welnigh into the whole Mesentery, and constitutes the *Arteriæ Mesaraicæ*, in the Gut Jejunum, Ileon and part of Colon: whose use is, 1. To communicate native heat into the neighbouring parts, and those whereinto they are inserted. 2. In a sickly state to receive the Excrement- of the whole body, as the Mesaraick Veins do, to empty them into the Guts, which use was first found out by *Spigelius*. 3. Some conceive the Mesaraick Arteries draw Chyle. 1. Because of their Carriage. 2. Because of their Ends. 3. Of their Contents. 4. The Authority of *Galen* in his 4. *de usu partium* and in his Treatise *An in Arteria sit sanguis ch.* 5. whom *Hofman* follows. But they cannot draw Chyle, because Chyle was never seen in them, and the Arteries receive nothing from the parts, but communicate somewhat to those parts whereinto they are inserted. Nor do they draw to the Heart, as *Varolus* would have it, for the valves hinder: and the Chyle is not natural to the Heart. Nor to the Liver or Spleen, as others suppose, because only the Splenick Arteries do carry vital Blood to the Spleen, and there is only one little Artery implanted in the Liver. Nor is it returned out of the Arteries into the Veins, as *Spigelius* imagins, for so there would be labour in vain; Nor do they carry this Chyle to the Cœliaca: because nothing ascends by the Arteries, but all descends by them to the parts. Therefore 4. The true use of the *Mesaraick* Arteries according to the Principles of *Walæus* is, to carry Arterial blood to the Guts, for their nutriment. Which motion of the Humors, Ligatures do shew in live-Anatomies. For the Mesaraick Arteries being bound, do swell towards the Trunk and the Heart, and are empty towards the Guts, which suck in the blood, and send back what is superfluous, through the mesaraick Veins to the Liver.

Whether the Blood of the Belly be circulated.

For the Blood is also circularly moved in the Abdomen, out of the cœliac and mesenterick Arteries, into the *Vena portæ*, notwithstanding *Riolanus* his denying the same, by his motion through the Trunks, because

1. There is the same Necessity which is in the Heart and other parts, the same Profit and the same Urgency.

2. Seeing there is an impulse of Blood without intermission, into the Meseraic and Cœliack Arteries, of necessity, they must either break, or Tumors and other Diseases must arise in the Mesentery, or it must run back again to the branches of the *Portæ*

3. Ligatures demonstrate the same here, as in other places.

4. The Valves observed by *Harvey* in the *Ramus splenicus*, permit the Blood to run back by the *Vena portæ*.

As to the contrary reasons it is to be observed.

1. That the Blood of the *Vena portæ* is not so impure, if it be compared with that of the *Cava*, but that it is somtimes purer than it; and though it be more dreggy, there is the more need for it to run back, to be made more pure by the Liver and Heart.

2. That there are in the Liver Anastomoses either of the *Vena portæ* and *Vena cava* (though they are not so apparent in a dead body) or such as open into the parenchyma of the Liver.

3. Somtimes there is a remarkable palpitation of the *Arteria cœliaca* in hypochondriacal disorders, which also *Mercatus* and *Fernelius* have observed, without any mutation of the Pulse, viz. the Hypochondrium being ill affected with Wind, or with some distemper, whereby the same Blood coming from the Heart, may be changed in this Region: but that by the Palpitation of the lower parts, the Heart is many times changed, *Tulpius* hath an Example. See also other Arguments, learnedly refuted by *Slegelius*.

The *Mesenterica inferior*, is distributed into the lower part of the Mesentery, and the left side of Colon.

But the other Arteries which accompany the Branches of *Cava*, are these following, excepting the *Mesenterica inferior*. For in this order the branches break forth from the *Arteria magna*, in the lower Belly. 1. *Cœliaca*. 2. *Mesenterica superior*. 3. The Emulgent. 4. The Spermatick. 5. The *Mesenterica inferior*. 6. The Lumbares; from which two Arteries are thought to accompany two Veins of the Brain. 7. *Musculæ superior*.

Afterwards the *Aorta* at the beginning of the *Os sacrum*, goes above the *Vena Cava* and no longer under, least smiting against some Bone in its perpetual motion, it should be hurt; also that the fore-parts, the shops of generation, because of their need of Heat, might be neer the great Artery. And in this place it is called

Iliaca, where it is divided like the *Cava* into the two Iliac Trunks, and each of them into the inner and and lesser branch, and the outer and greater which go to the Thigh.

But before they become crural, they send out on each side

side six branches. The *Sacra* presently after the bipartition: from the inner Trunk the *Musculainferior*, the *Hypogastrica* and *umbilical Arteries*: from the *Epigastrica* and *Pudenda*; The rest of the Artery is carried into the Thigh and makes the Crural Arteries.

Chap. 6. *Of the Crural Arteries.*

OF the Crural Arteries, on each side, are constituted these following Arteries.

Above the Ham, for the *exterior* parts of the Trunk, *Musculi cruralis extèrna*, to the foremore Muscles of the Thighs; from the *inner*, the *Musculi cruralis interna*, to the inner Muscles of the Thigh; and this is mingled at the Knee, with a small branch or twig of the Hypogastrica.

Under the Ham arise three branches:

1. The *Popliteus*, into the hinder Muscles of the Thigh.
2. The *Suralis*, which is divided into the *Tibicus exterior*, the *posterior altus* and *posterior humilis*, for the Muscles of the Leg.
3. The rest is spent upon the Foot and its Toes.

THE THIRD MANUAL Of the Nerves, Answering to the THIRD BOOK OF THE HEAD.

CHAP. I.

Of the Nerves in General.

The significations of the term Nervus.

BY the Term *Nervus* the Ancients did sometimes signifie a Ligament or Band, hence the Comædian saies, He will come to the *Halter*, *in Nervum ibit*: but it properly signifies a common Organ, which together with animal spirits, carries the faculty of moving and feeling, wherefore *Aurelianus* calls the Nerves *sensuales viæ*.

A Nerve what.

A Nerve therefore is a common Organ long and round, to carry the Animal faculty lodged in the Animal spirit, into the parts of the Body.

The *Effisient* is the Nerve-making faculty.

The Matter according to *Hypocrates*, is a clammy and cold part of the Seed, heated but not burnt: and *Galen* saies 'tis a matter white, thick and roapie. And this is the Beginning of its Generation.

The Beginning of the Nerves.

The Beginning of the Dispensation of Nerves or the part whence the Nerves immediately arise, is the *Medulla oblongata*, partly as it is within the Skull, and partly as it is in the Back-bone. Within the Skull arise those which are commonly said to arise from the Brain, *viz.* the seven pair of Nerves: and in the Back-bone thirty. And this most true opinion is confirmed, not only by the similitude of the Marrowie and Nervie Substance, but also by ocular experience.

The Error of Aristotle.

Aristotle would have them arise from the Heart, who is followed by *Alexander*, *Averroes* and *Aponensis*, who nevertheless say it comes by mediation of the Brain.

Others would have the Nerves to be nothing else but the Veins and Arteries continued, and degenerating into Nerves: as *Praxagoras* of old, in our daies *Cesalpinus*, *Reusnerus*, *Hofmannus*, and *Martianus*, but they are out; seeing 1. In the Brain there is no Conjunction of Arteries and Nerves by Anastomoses. 2. An Artery being hurt or cut in the Head, no Convulsion follows. 3. The distinct Rise of the Nerves in the Brain is apparent, as of the Arteries in the Heart.

Erasistratus did conceive they came from the *Dura Mater*.

At this day many Physitians conceive with *Galen*, that some Nerves arise from the Brain, others from the Spinal Marrow: who are all confuted by *Ocular inspection*.

Their *End* and Use is, to carry the Animal faculty with the Animal spirit, from the Brain, like conduit pipes, into the parts.

1. Sensory, as the Eyes, Ears, &c.
2. Motive, as the Muscles.
3. All in a manner, that they may in general perceive and understand what causeth pain.

And therefore the Nerves inserted into the parts, do give to the said parts either Sense alone, or Motion alone, or both Sense and Motion: nor is there any voluntary motion or sense without the help of a Nerve; and therefore a Nerve being cut, that part is presently deprived of Sense and Motion.

The *Nerves* therefore, I say, do *afford* to the parts either *Sense* or *Motion*, according as they are disseminated into such and such parts, because the Nerves of themselves are not *sensitive* or *motive*.

whether the moving Nerves and the sensitive differ.

So that if they be implanted into Muscles the Organs of Motion, they are termed motive Nerves; if into the Instruments of sense, sensitive. Many times also according to the Nature of the Parts, one pare of Nerves affords both sense and motion. As the sixt pare of the Nerves of the Brain, commonly so called, is communicated to the Bowels of the middle and lower Belly to cause the Sense of Feeling; and when it becomes recurrent, it bestows

motion

motion upon the Muscles of the Larynx. The optick pare so called, gives only sense, because implanted into the Eyes only. But the other pare which is termed *motorium par*, the moving pare, and arises from the marrow as well as the former, causes motion because it is implanted into the Muscles of the Eyes.

The *Situation* of the Nerves, for securities sake, is more profound and deep than that of the Arteries.

The *Magnitude* is various, according to the condition of the Organs and dignity of the Actions, their Assiduity and Magnitude. The optick Nerves are great, because the action of the Eyes is so; also those Nerves are most thick which are sent to remote and many parts, as the Limbs; indifferent in the sensory parts; for because they were to be soft, they could not be very small: the Nerves of the neerest parts are smallest of all, as in the Muscles of the Face.

A new opinion of the Author touching the number of the Nerves.

The Nerves are commonly said to be *seven and thirty pare* in *number*; seven pare from the Brain, which I say arise not from the Brain, but from the *Medulla oblongata* within the Skull, and thirty from the Marrow in the Back-bone. But I say that indeed & in truth, those seven pare, are ten pare, as shal be made apparent in the *following Chapter*: and so I make forty pare of Nerves: *ten arising within the Skull*, and thirty without in the Back-bone.

The former were indeed by the Ancients reckon'd to be only seven in number, and to arise from the Brain, which they comprehended in this verse.

Optica prima, Oculos movet altera, tertia gustat
Quartaq; Quinta audit, vaga sexta est, septima linguæ.

First sees, next moves the Eyes; third, fourth do tast,
Fift hears; sixt roams, seventh moves the Tongue too fast.

But the smelling pare was by them omitted, and that which they make the third pare, is double and distinct; so the fift is double; one pare of which duplicity, some have made to be an eighth pare; for *Archangelus* reckon'd eight pare, *Columbus* nine, and I ten, as shall be said hereafter.

Now the thirty pare of the Marrow of the Back are so divided, that seven are of the *Nick*, twelve of the *Chest* or *Back* (others say eleven) five of the *Loyns* (sometimes four) and six of the *Os sacrum*.

All these Nerves do sprout out of both sides, and therefore they are termed *Pares of Nerves*; *Susugiai* conjugations or coupling of Nerves. And it is necessary for a Physitian to know their originals and distinctions, that he may understand to which part of the Back-bone Topicks are to be applied, when motion or sense, or both are impaired in the Face, Neck, Hands, Muscles of the Belly, Yard, Fundament, Womb, Bladder, &c.

The use of this Doctrine in Physick.

The Nervus sine pari.

Moreover as to number, you must know that every Nerve hath its mate or Companion, except the last or lowest proceeding from the spinal Marrow.

Why the Nerves are not hollow.

The figure of the Nerves is long, round, and smooth like Conduit pipes; but without any hollowness as the Veins and Arteries have: because the later with Spirit were to carry Blood, but the Nerves carry only Spirit.

Riolanus the Father excepts the Nerves of the Privity manifestly hollow, which nevertheless his Son excuses to have been meant of the hollow Ligaments of the Privity, who is better verst in Anatomy than his Father was, and so also *Laurentius* spoke. *Severinus* in his Zootome, saies, the Nerves of a *Bulls pizzle* are hollow.

Whether the Optick Nerves are hollow.

Galen also adds the Optick Nerves, which he will have to be hollow and perforated, sensibly and manifestly: for the discerning whereof he conceives three things are necessary, *viz.* That 1° The Animal be great. 2. That it be cut up as soon as killed. 3. That the Air be cleer and bright. *Plempius* doth also require three things more, that the Nerve be cut asunder with a most sharp Knife, that it be not squeezed nor stretched, and that it be cut beyond the growing together of the two Nerves. *Cornelius Gemma* subscribes to *Galen*, who attributes rather a passage to be seen like a prick in the inner substance of the Nerves.

Others conceive the porosity is better seen in the optick Nerves being boiled. *Fallopius* saies that *Galen* thought thus, because in the Bodies of Apes which he dissected, all Nerves are pervious. Howbeit *Spigelius* admits only certain passages in the beginnings of Nerves, where they grow together, and soon after towards the Eyes it vanishes. I also saw a Cavity and Publickly did shew the same in a dead body, after they were joyned, and before they entred into the Eye.

But *Vesalius*, *Eustachius*, and *Coiterus*, deny these Nerves to have any Cavity against *Galen*; and so do others, and produce experiments which succeed not, unless the conditions aforesaid be observed.

All the rest of the Nerves do want a manifest Cavity; but they have *Pores*, through which the subtile spirits pass, least we should grant penetration of bodies which is impossible. These pores are double according to *Hogeland*, *lesser* and *greater*; through the former subtil aerial bodies pass to move the parts; by the later, bodies less subtil. Neither of them is discernable to the Sense. Nor are there two sorts of Spirits in the Brain. I am rather apt to believe that according to the Indigence of every part and the pleasure of the will and the Imagination, sometimes more spirit passes through the greater, sometimes less through the lesser, which the more plentiful or scanty influx of the Spirit doth make.

Moreover all the Nerves do consist, none excepted, of many nervous fibres or filaments which grow mutually together by little Membranes. I my self, with *Johannes Leoniceus*, a right diligent Anatomist, have observed the Trunk of Nerves neer the Hips, if it be dissected, to shew a Cavity as it were, consisting of an infinite contexture of fibres, like little Worms, whereas elsewhere it is one continued body, with cohæring and continued fibres.

The *Substance* of the Nerves is thought to be threefold: the internal, white, and marrowish (by which as the Centre the action is performed) from the marrow of the Brain, but more compact and thickned; and an external, being a twofold coat; the outer harder, proceeding from the *Dura Mater*; the inner finer, from the *Pia Mater*. Which Membranes do the same for the Nerves, which the *Dura* and *Pia Mater* do for the Brain. Howbeit this distinction of Substances, is to be searcht out, rather by Reason than by Sense.

Cartesius supposes that there are Valves in the Nerves, which stop the Spirit that it may not flow back, otherwise the parts cannot be moved. But it seems to me, the Spirits may not be retained in the parts, which the Soul that directed the Spirit as far as to the Valve, shall direct it into the very parts. For no Anatomist as yet hath observed any Valves. Nor can subtile Spirits be stopped by Valves. Nor would Apoplexies or Palsies so easily happen, if the Spirits could be detained in the parts by Valves.

Besides Valves *H. Regius* introduces likewise a circulation of the animal Spirits in the Nerves. For after they are distributed from the Brain to the whole Body, he conceives part is dissipated by insensible Transpiration, and part being insinuated into the Veins, is mingled with the Blood, and returns with it into the Heart, and thence again into the Brain and Nerves. He proves this by the example of a Snail enclosed in a glass, in which the spirits through its transparent Body, are seen to move and pass from the Tail through the Belly, to the Head; and from the Head through the Back, to return to the Tayl, and from thence to the Head again.

But some doubts with-hold me from assenting to this witty conjecture, because

1. *Walæus* searching out the Motion of the Animal spirits with all his diligence, could finde nothing but the motion and distention of the Muscles. For the Nerves being bound, do not swell, nor are distended, and being cut asunder, they shew no other motion, but that they are contracted into themselves.

2. There is no need that the spirits should run back to the Veins, because being subtile they are easily consumed, and by his own Confession do insensibly exhale.

3. New spirit is evermore supplied from the Brain, which may supply the Defect of that which is consumed.

4. The Veins need none, because they possess that spirit which is proper to the Blood, nor are they moved with animal motion.

5. The Nerves themselves are not moved by Systole and Diastole, nor of themselves as was said, because it appears not when they are bound, and they move with a voluntary motion by the Muscles, and not by the arteries because they are smaller and go not into them: finally the Nerves are unfit for such a motion because of their Slipperiness.

6. In a Snail the Spirit aforesaid is instead of Blood, which Snails have not.

7. I have seen those who had their senses perfect, and the motion of all their parts free to the last gasp, whose Pulse did nevertheless intermit for certain daies, where there was no regress of the Spirits to the Veins, freely passing nevertheless from the Brain to the parts of the Body, as long as there was any left.

Nerves hard or soft.

It is now to be observed that all the Nerves are not alike hard or soft; whence *Galen* reckons some *Nerves soft*, others *hard*: the former he calls *sensitive*, the later *motive*. Now the Nerves become *harder*,

1. Because of their *Production*, as being to go a great way, or through some hard Body, or by a crooked way. And by how much they are further from the Brain, by so much the harder they are. Hence the short Nerves, as those of the Sight, Taste, Hearing are soft, and those of the Smelling softest of all.

2. *For use*, for hard Nerves are held to be fitter for motion, soft ones for sense. And therefore the Organs of the Senses have received soft Nerves, that they might be the sooner affected by a sensible object occurring. Now all parts which have voluntary motion have hard Nerves, because that which is hard is fittest to act, that which is soft to suffer.

Why the moving Nerves are hardest.

The Use therefore of all the Nerves is,

1. To carry *animal Spirits* to all parts for sense and motion, which appears when they are hurt. For if they are obstructed in the beginning or totally, they both perish and an Apoplexy is caused: or in part, and then one part of the Body is deprived of sense and motion. If they are cut asunder, the motion of that part is lost, into which they were inserted.

2. To diffuse *Animal light* into the parts. For the animal Spirits could not so soon be taken away, either in a Ligature, or Obstruction of the Nerves, but that those Spirits which remain in the part, might cause motion or sense. Therefore the *direction* of the Brain proceeds from some what else, which being taken away, the parts presently cease from performing their functions, even as the Hammer is by the Hand directed unto the Anvil, and a Staff is directed when it is hurled, which others endeavour to explain by some hot *Accident* beside the Animal Spirit. But I suppose these things are done by a light which irradiates from the Brain, with the spirits, which being intercepted, the parts are immedately deprived of Sense and Motion, as the light of the Sun is taken away by a Cloud, and the light of a Candle, by holding a mans hand before it. For,

1. No other influent cause, can flow in so suddenly, and be withdrawn so suddenly.

2. Light is the cause of all motion wellnear in the Universe, and nothing is swifter than it is.

3. Sometimes it remains after interception, but not long, as light received into the Bononian Stone, and a Stick by me violently darted, and broken in the middle way, does fly yet further, by the motion impressed from my hand.

3. The Temper of the Body follows the Figure and Temper of the Nerves, and therefore *Joh. Damascenus* in the seventh Aphorisme to his Son, advises, in giving of Medicaments to avoid such as dissolve the force of the Nerves.

Chap. 2. *Of the ten Pare of Nervs, which arise within the Skull, from the Medulla Oblongata, and their progress.*

I Make the first Pare to be *Par Olfactorium* the Smelling-pare, whose processes are termed *Mammillares*. And these processes have been sufficiently known to all: but the Nerves, to which they are fastned behind, and well near continued, to none or very few.

Whether there be any smelling Nerves.

These Nerves slip out of the Marrow about the Saddle of the Sphænoides, near the foremore Ventricles, and have the carriage, colour, and use of Nerves, and therefore I reckon them for Nerves.

A Præoccupation

For they must not therefore be robbed of the Name of Nerves, because they pass not without the Skul, and *Dura Mater*, and are not afterward invested herewith, for then all the other Nerves as long as they are within the Skull, must not be called Nerves, which were absurd.

Processus Mammillares.

To these Nerves are adjoyned two thick portions or processes called *Processus Mammillares*, papillares: the Teat-like processes.

They are in *Number*, two, *white*, *soft*, *broad*, *longish*, in men thin and small, in Brutes greater, especially in Dogs, and other Creatures that have an exquisite Smell. For,

The Organ of Smelling.

The *use* of these Processes, is to be the true Organs of Smelling, and not the Nose nor its coat.

These Processes are *placed* in the fore-part of the Brain, behinde the Colander-bone, and to it being covered with the *Dura Meninx* they put a face. Through the Colander-bone the Odours ascend.

The *Second Pare*, which others count the first, is the Optick or seeing pare, because it carries the seeing Spirits to the Eyes, or the representations of visible objects to the Brain, but not humours from the Brain to the Eye to nourish it, which is the fiction of *Cæsalpinus*. *Hierophilus* calls them *poros opticos* or *meatus*, the optick pores or passages, because they are thought to be hollow.

These Nerves, of all the ten pare, are the greatest and thickest, but softer than the rest.

The Error of others about the rise of the Optick Nerves.

They arise, not as the *common Opinion* is, from the fore-part of the Basis of the Brain; for their original must be sought further, towards the hinder part of the Head, where they are carried between the Brain, and the beginning of the spinal Marrow, and arise out of the beginning of the first Trunks of the Medulla Oblongata

oblongata, growing out of the Brain. But *Riolanus* demonstrates, that they are turned round about those great Eminencies of the Brain, which *Galen* cals *Thalamos nervorum opticorum*, which reach unto the foremore Ventricles, that they may fetch optick spirits from thence.

The Union of the optick Nerves and the true Cause thereof.

And having proceeded a while, they are neer the middle way united above the saddle of *Os Sphænoides*, not by a simple touch or intersection, in Mankind, but a total confusion and mingling of their Substances, that they might suffer the less, in the middle of a long passage, by reason of their softness. *Vesalius*, *Aquapendens* and *Valverda* have observed that they have somtimes continued divided, in their whole Course. *Vesalius* also observed that in a Woman they were joyned only by mutual Contact, whose right Eye had been withered from a Child; because the right Nerve was smaller than the left, beyond the Conjunction. But in most bodies the inner substance of the Nerves is confounded, as I have observed by accurate Inquisition.

The growing together of the optick nerves, was therfore contrived by Nature, either lest the sensible object being received in by both Eyes should seem double, or that the Visive spirit might, if need were, be all conveighed into one Eye which are the conjectures of *Galen*, or finally for strength and stability here necessary, least in Concussions of the Brain they might hap to be broken or distorted, or least thtough the softness and moistness of the Brain and optick Nerves, by reason of distillations and other Excrements they might become flaggie, and so driven out of their right station; which is the opinion of *Plempius*.

Soon after being seperated they go out of the Skull into the Centre of the Eyes in Mankind, but much lower in Beasts, because they look more sidewaies.

Within the Skull they are cloathed only with the *Pia mater*; but from the holes, which pass to the Eyes, they are covered with the *dura mater*. Afterward it spreads the latter to the *Sclirotica tunica*, the former to the *Tunica choroïdes*, and its inner marrowy substance to the *Retina*.

The *third pare*, which others count the second, is the *motorium oculorum*, the *Eye-mover*, next unto the former.

The Error of others about the Rise of the Eye-movers.

This pare is thought by vulgar Anatomists to arise from the Brain, neer the original of the first pare. But it reaches to the middle of the Head, goes beneath the Opticks cross-wise, and

Why one Eye being moved, the other moves also.

Arises at the inmost part of the Beginning of the *medulla oblongata*, where in their Rise, these two motive-nerves are so united as to touch one another, yea to become one continued Body, which is the cause, that when one Eye moves, the other is moved also.

Why somtimes when the temporal muscle is hurt, the Eye is hurt likewise.

This Pare is *lesser* and *harder* than the former and stretched out by the visive pare; goes out of the Skull at other holes to the Muscles of the Eyes and Eylids. It somtimes though seldom sends a branch to the temporal Muscle; and that is the Cause that the said Muscle being hurt, the Eye is hurt, and the Eye being hurt that is hurt.

The *Fourth*, *Fift* and *Sixt* pares are much confounded by Anatomists. For some make the fourth and fift Pare one, and call it the third Pare, consisting of two roots; the lesser of which some do make the third pare, and they themselves do make the fist and sixt pare one, viz, the fourth pare by them so called. But those who reckon it for one, they count the fourth pare, according to my reckoning, for the lesser root of the third pares and the sixt pare for the fourth. whereas we distinguish all these pares.

The *fourth pare* therefore, which others as *Bauhine* count the third; others as *Fallopius* the eighth pare; others badly, the lesser root of the third pare: for it hath nothing common with the following pare, is not joyned to it, either in the Beginning or the Progress, and grows out of the order of other pares; according to some

From the side of the Beginning of the *Medulla oblongata*; according to others it *grows* with a very small Nerve, out of the lowest and hinder seat of the *Medulla Cerebri* or marrow of the Brain: then it is carried forwards, and fastned to the second pare, it goes with it out at the common hole, enters the socket of the Eye and sends out from it self branches

Into the fat of the Eye, the fist Muscle, and by a peculiar hole of the Bone of the Fore-head, it goes out to the Skin of the Fore-head, and the upper Eye-lid. And these are furnished by its *first branch*.

The *second* furnishes the Muscles of the upper Lip, and some of the Nose, and the Lip it self and Gums.

The *third* by the Cavity of the Nostrils serves the coat of the said Nostrils.

The *fourth* serves the inner part of the temporal Muscle. All which branches *Fallopius* doth attribute to the two following Conjugations: but my distribution is propounded by *Vesalius*, *Columbus*, *Platerus*, and *Bauhinus*.

The *fist Pare*, which others count the thicker root of the third pare; is commonly thought to furnish the Tongue with the sense of Tasting.

This *arises* neer the following Conjugation, out of the sides of the *Medulla oblongata*, and presently after its passage through the *Os sphenoides*, a writhen branch comes out like a tendrel of a Vine (which some think is done to make it harder) and is united with two little twigs of the auditory Nerve.

It furnishes the Muscles of the Face, the Temporal Muscle, the chewing Muscle of the Cheeks, the Skin of the Face, the Gums and Teeth (for by their means the Teeth have all the sense they have) the Muscle that lies concealed in the mouth and the lower Lip.

The *sixt pare*, which some call *Quarta conjugatio*, others the smaller root of the fourth Conjugation,

Hath a smaller *Original*, next the former, and somwhat harder than it.

Whether the sixt pare be the same with the fist.

It goes through a common hole with the former, and yet it doth not therefore become one pare with the former: for the third, fourth, and seventh pare, as I reckon them, do also pass through one and the same hole.

It is carried into the Palate. Others would have this pare also to serve the sense of Tasting.

The *seventh pare*, which others count the eighth, others the ninth, others the smaller portion of the fift pare, when as in the mean while it is a peculiar pare smaller and harder than the fist, also distinct therefrom in its original and progress:

For it *arises* a little before the fift commonly so called, in the middest of the *Medulla oblongata*, and going over the third pare, and cutting the same, it proceeds along between the third and fourth pare, where it is carried upwards and forewards, towards the sides.

It goes out of the hole with the third and fourth pare, and is commonly quite spent upon the *Musculus abducens* of the Eye. But that is a question, which others say, that it is carried into the temporal Muscle, and into that which lies concealed in the Mouth.

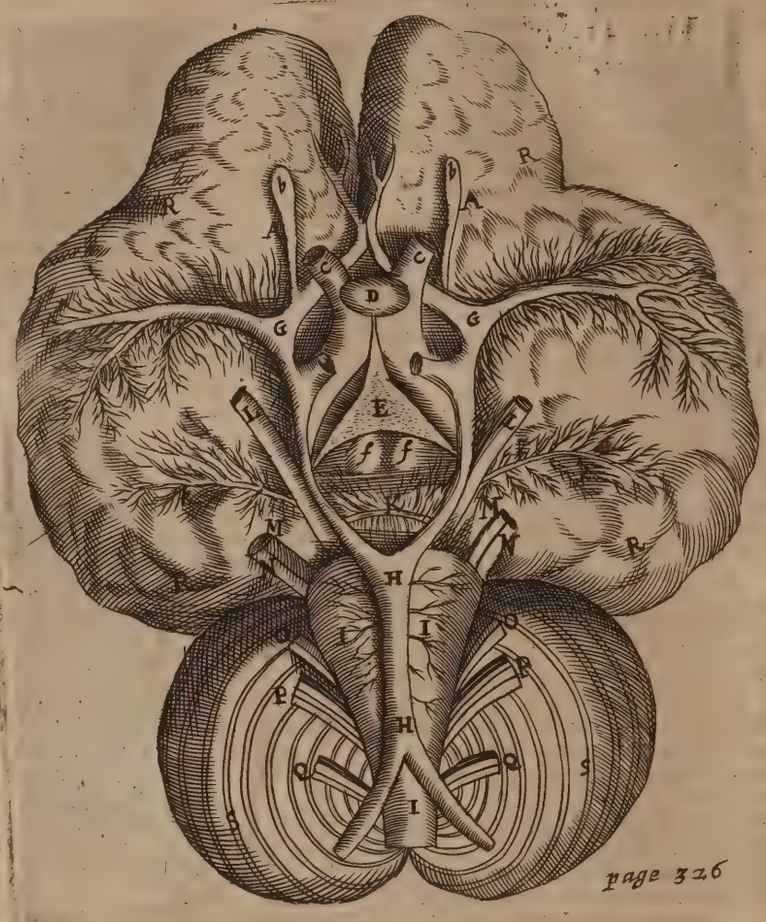
The *Eighth pare* which others count the fift, which is called *Auditorium*, the Hearing pare, arises close by the sides of the former, only a little below. It enters the *Os petrosum*, and is *divided* into the *greater* branch, which being spred out, they wil have to make the Drum, and the *lesser* broad below, as if it would accompany the sixt Conjugation.

The Explication of the FIGURE.

This TABLE presents the Original of the Nerves to be seen in the Brain turned underside upwards.

AA. *The Smelling Nerves reckoned by our Author for the first pare.*
bb. *Their mammillary processes, or Teat-like productions.*
CC. *The optick Nerves cut off neer the Eye-holes; the second pare.*
D. *The Glandula pituitaria.*
E. *The Infundibilum or Funnel.*
ff. *Two white kernels set before the passage of the Brain.*
GG. *The greater Branch of the Carotick Artery.*
HH. *The Arteria Cervicalis.*
III. *The Beginning of the spinal marrow within the Skul.*
Kkk. *The small branches of the Arteries, which others call the Rete mirabile.*
LL. *Nerves of the third pare according to our Author.*
MM. *The Beginnings of the Nerves of the fift pare.*
OO. *The Nervi Auditorij, or the eighth pare.*
PP. *The Beginnings of the ninth Pare.*
QQ. *The Rise of the tenth Pare.*
SS. *The Cerebellum or Brainlet.*

TABLE I.



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Why we cough when the Ear-picker goes far into our Ear.

It sends branches through the first and second Vertebra to the proper Muscles of the Larynx: and therefore it is that picking our Ears too deep, a dry Cough is caused. It is thought somtimes to send branches to the Arm, with the fourth, fift and sixt of the Arm; and somtimes into the whole Foot, with the Nerves of the Back-bone, after it hath accompanied the Spinal Marrow going downwards.

The *ninth pare* which others call *par sextum* and *vagum*, the sixt and roaming or wandring pare; because it furnishes very many parts here and there, yea and all the internal parts seated in the middle and lower Bellies, which receive branches for sense, seeing they are soft bodies, nor can away with the harder sort of Nerves springing from the spinal Marrow. And because of the long way they go, they are *cloathed* with strong *Membranes*, and are carried united to the neighboring parts.

This Pare *arises* a little beneath the foregoing, sundry fibres being presently united.

It goes out through the hole of the *Occiput*, through which the *Ramus major jugularis internæ* had ascended: and not far from its egress it provides for the Muscles seated in the Neck, especially the *Cucularis*. Then the Trunk descends, and is knit with the last pare, the Carotick Artery, and Jugular Vein; and sends branches athwart, through the Membrane and Muscles of the Larynx, also the Muscles of the Hyoides and the Fauces, as also to the Tongue.

Then descending between the Carotick and Jugularis, to the side of the Wesand above the Jugulum, it is divided on each side into the exterior and interior branch.

The Recurrent Nerves.

The *Exterior* constitutes the *recurrent Nerves*, or vocal Nerves so called, because they being wounded the living Creature looses its voyce; so that if one be cut asunder, half the Voyce is lost; if both, the animal becomes dumbe. they are also termed *reversivi* or *recursivi*, running-back; for first they descend, and they turn afterwards back again as it were about an Axle-tree on each side, the *right* about the *Arteria axillaris*, the *left* about the descending Trunk of the Artery: and afterward they ascend as high as the Muscles of the Larynx, to which they give numerous branches. which recursion was to be made, because the Muscles of the Larynx have their Heads, not above but beneath.

And therefore the *Exterior dexter* of the sixt pare, presently after the division, furnishes the Muscles arising from the Breast-bone and Clavicula; then the right Recurrent being constituted for the most part of three little twigs bended back and united, it descends obliquely under the Jugulum, and in its passage shoots out little branches for the Coat of the Lungs, the Pleura, the Pericardium and the Heart; and then makes the right stomachic, under the Gullet joyned to the left; and passing through the Septum, it goes into the right Ventricle of the Stomach to the left branch.

The

The *Exterior Sinister*, furnishing the Parts in the same manner as the former, and constituting the left Recurrent, it sends forth the *Stomachicus sinister*, which with its fellow compasses the orifice of the Stomach and the remainder goes to the Pylorus and hollow of the Liver.

The *Interior dexter* first of all gives a Branch of it self, at the roots of the ribs, to every intercostal Nerve; and then with the great Arterie it passes through the Septum, and furnishes the whole lower Belly, till it reach as far as to the Os Sacrum. And then it goes into three Branches.

How Hoarsness comes after the Cholick.

I. Goes to the Call, from whence arise other three twigs, 1 To the Colon, hence after a long Colick comes hoarsness. 2 the smallest scarsely visible, to the beginning of the Guts. 3 To the right side of the Bottom of the Stomach, the upper Membrane of the Call, the Coat of the Liver, and the Gall-Bladder.

II. The *inferior* to the right Kidney. Hence they assigne the cause of Vomiting, in fits of the Stone in the Kidney.

Why Vomiting in the stone of the Kidney.

III. The *greatest* to the Mesentery, Guts, and right side of the Bladder.

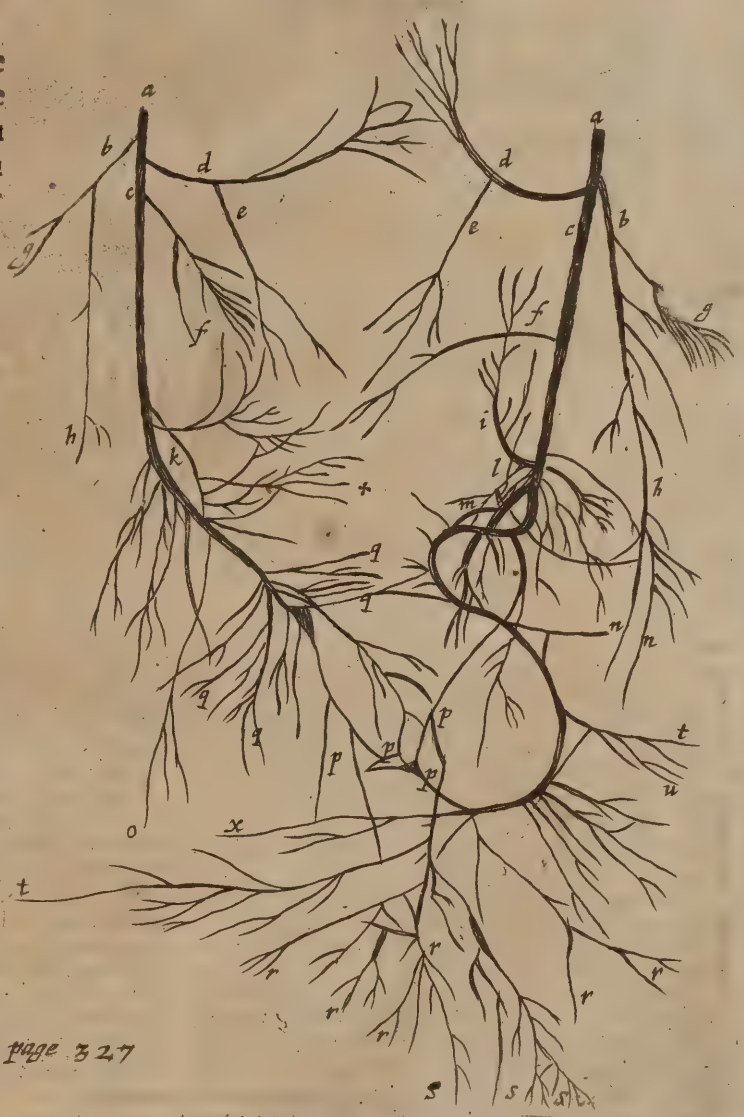
The *Interior sinister* in its side is distributed after the same manner, save that in stead of the Liver part thereof goes unto the Spleen. But from both the interiors, sometimes Branches are sent unto the Womb.

This is the distribution of the sixt Pare according to the vulgar computation, the Ninth according to my account.

The FIGURE Explained.

This TABLE presents the lower Branchings of the sixt pare of Nerves, which our Author calls the Ninth others the wandring or roaming pare.

The II. TABLE.



aa. *The comeing of the said Nerves out of the Skull.*
bb. *The Ramus externus on both sides.*
cc. *The Ramus internus on both sides.*
dd. *A remarkable Branch spred into the Tongue.*
ee. *A Branch arising from the same on each side, which goes to the Muscles of the Larynx.*
ff. *Another twig which goes with the former to the Larynx.*
gg. *Twigs arising from the external Branch, and propagated to the Muscles of the Neck.*
hh. *The conjunction externi Rami singularis, with Nerves which arise from the plexus of the Neck.*
ii. *The recurrent Nerve on each side.*
k. *The more internal Branch arising near the first Rib of the Chest, which bestows the twig thus X marked upon the Trunk of the Wesand, and then descending ends into the Pericardium or Heart-bag.*
l. *A little Branch arising from the recurrent, which descending produceth another twig out of it self, and goes into the pericardium, and at last is implanted into the external Branch*
m. *The twig arising, as was said, from the same, and diffused into the pericardium.*
nn. *Two twigs arising from the external Branch, the one of which is implanted into the Substance of the Heart, and the other tends to the Beginnings of the Vessells.*
o. *The aforesaid Branch implanted into the pericardium.*
pppp. *The Plexus or contexture of both Branches, viz. of the right and left, about the Gullet, near the upper Orifice of the Stomach.*
qqqq. *Twigs spred abroad into the Lungs.*
rrrr. *Branches propagated into the upper parts, especially of the Stomach.*
ssss. *Four remarkable Branches, which descending into the Mesentery, are spred abroad to the guts.*
tt. *The right and left Nerve-twig of the Kidneyes.*
u. *The Nerve-twig of the Spleen.*
x. *The Nerve of the Liver.*

The

The *tenth and last pare* of Nerves, arising within the skul in the hind part of the Head, out of the Medulla oblongata when in is ready to slide into the Back-bone, is as others reckon the seventh pare.

This is *harder* then the rest, and it springs from divers roots afterwards united, and goes out of the Skul at a crooked hole propper to it self. And soon after it is with strong membranes joyned, not mixed with the precedent pare, for safe-gaurd sake. And then it is separated again, and goes the greatest part of it into the tongue, and some small part into the Muscles of *Os hyoïdes* and the Larynx.

CHAP. III.

Of the Nerves which proceed from the Spinal Marrow, and first of the Nerves arising from the Neck, and so of the Nerves of the whole Arm.

AND so much for those ten pare of Nerves, which proceed from the *Medulla oblongata* within the skul: the other pares do now follow, which are thirty in number, somtimes nine and twenty, from the same beginning, viz. the *Medulla oblongata* being passed out of the Skull into the Back-bone: where it is termed *Medulla spinalis* or *Dorsalis*, the Marrow of the Back. Now the little Nerves proceed out of the holes of the Back-bone, in a continued course bending themselves inward, from the uppermost to the lowermost.

Out of the Marrow, while it is in the *Neck*, there arise *seven pare* of Nerves as some reckon, *eight* pare as others count, disseminated into the whole outward Head and the neighbouring Muscles.

The *first and second* pare have this peculiar above all the rest, that they *proceed* not from the sides, but from the fore and hinder part, by reason of the peculiar Articulation of the first and second Vertebra.

Now the first pare arises between the hinder-part of the Head and the first Vertebra. *Joh. Leonicenus* of *Padua*, a dextrous Anatomist in taking out of the Nerves, denied that there was any such pare as this, because he could neither see it, nor can it come out of the first Vertebra having no hole, and sticking closely to the second Vertebra and the Occiput.

The *second* pare arises between the first and second Vertebra, and so of the rest in order.

The first and second pare are *disseminated* into the Muscles of the Head, and to the Ears.

The *third* and *fourth* into the Muscles of the Cheeks, also those which are common to the Head and Neck.

The *fift* with the branches of the fourth and sixt, do make the remarkable midrif Nerves: and the fift with the foresaid, sends a part backwards, and a part forward into the Muscles bowing the Head; those of the Arms, Shoulderblades, and the Skin there.

The *sixt* to the Arms and the hollow of the Shoulderblades.

The *seventh* is joyned with two of its Neighbours, viz. the sixt of the Neck and first of the Chest, whose greatest part goes to the Arms and as far as the Hands.

For there are carried *into the Arms five* or six pare of Nerves, viz. from the *fift*, *sixt*, and *seventh* pares of the Neck, also from the first and second pares of the *Chest*. which when they first break forth, they are all mixed and united, nor are separated without dammage, and soon after they are severally divided into the foresaid Pares; to the End haply, that by that light concourse, a collection might be made of animal spirits. Hence Topick Medicaments, in a Palsie, or Convulsion of the Arm, the upper part of the Arm being affected must be applied on the side of the upper part of the Back and the Neck, from whence the Nerves proceed, not directly in the middle, either of the Back or Neck, unless by reason of the common beginning of the Nerves.

The Nerves of the whole Arm.

The *first Pare*, from the fift pare of the Neck, goes chiefly into the Deltoides Muscle, and the Skin of the Arm, leaving a part which accompanies the *Vena humeraria*.

The *second* being thicker, is carried through the Middle and Forepart of the Cubit, where it furnishes the *Musculus biceps*, whereupon it is joyned with the third Nerve, and afterwards going downwards, it salutes the *Supinator longior* with a twig: but at the bending of the Cubit, it is divided somtimes into Two, otherwhiles into three branches.

1. The *upper* and *lesser*, goes along the outside of the Arm, to the outer part of the first or second Interjuncture of the Thumb.

2. The middle and thicker descends obliquely within the Cubit to the Wrist.

3. The lower, being stretched along by the inner branch of the Basilica, is spent into the Skin of the Cubit and Hand.

The *third* is joyned with the former, under the Muscle Biceps, it provides for the Brachiæus and the inside of the Hand.

The *fourth* being the thickest, goes along with the *Vena profunda* and the Artery, Afterwards is variously divided. Now it furnishes the Muscles which extend the Cubit, the Wrist, the Thumb, the fore and the middle Finger, and the Muscles which stretch the Fingers out.

The *fift* stretcht along by the former, between the Muscles of the Cubit, which it furnishes descending through the lower and hinder part of the Cubit (where when we strike against any thing or compress the Nerve, we feel a nummedness in our fingers) in the middle thereof it is divided into two.

One branch goes externally through the *Ulna* to the Middle Finger, Ring-finger, and little Finger. On the Inside of the Fingers for securities sake, that they may give place in laying hold of any thing, for there Wounds are more pernicious than in the middle.

The other goes inwardly through the *Ulna* betwixt the Finger-bending Muscles as far as the Wrist, and sends branches to the same parts as the former sent to.

The *sixt* is spent into the Skin of the Cubit, going betwixt the Skin and the Membrane.

CHAP.

The FIGURE Explained.

This FIGURE presents the spinal Marrow and the Nerves derived therefrom to the Limbs.

A. *The beginning of the spinal Marrow neer the Skull.*
bbbb. *The Boughs orderly propagated from the Medulla.*
ccc. *The Body it self of the Marrow, half included within the Vertebræ, above which little Veins and Arteries spread themselves.*
DDdd. *Branches arising from three pare of Nerves of the Neck, and two of the Chest, to be distributed into the Hand.*
E. *The Contexture and Commixion of those Nerves.*
ff. *The first pare of Nerves of the Hands.*
gg. *The second Pare.*
hh. *The third Pare.*
ii. *The fourth Pare bigger than the rest.*
k, k. *The fift pare.*
l. *The sixt pare which is under the Skin.*
M. *The first Nerve of the Thigh.*
N. *The second Nerve.*
ooo. *The branch of the second Nerve which accompanies the Saphæna.*
PP. *The third Nerve of the Thigh.*
QQQ. *The fourth Nerve of the Thigh, thickest of all.*
rr. *The Ramus externus.*
ss. *The Ramus internus.*

CHAP. IV.
Of the Nerves of the Chest, the Back and Loyns.

FRom the Marrow of the Back arise *twelve pare*, or as some reckon eleven all and every of which after thir Egress are *divided* into the greater and lesser branches: the one of which is carried forward, the other backward, being bowed backwards.

The *foremore* branches, are sent into all the Intercostal spaces, the internal and external ones (both which I have somtimes seen divided into two branches) for the Muscles which lie upon the Chest, also for the oblique descendent of the Belly.

The *hindermore* and lesser branches go backwards to the spines of the Back, betwixt the Muscles which grow to the Vertebræ, into which they are partly consumed, and partly into those which grow from these points of the Spines, as into the *Rhomboides, Cuculares, &c.*

Out of the spinal *Marow* when it is in the Vertebræ of the Loyns, there arise somtimes *five*, somtimes *four* pare of Nerves: which pares are greater than those of the Back. And each of these is divided into the foremore and hinder branches, which are disseminated, partly into the Muscles of the Loyns and Hypogastrium, and partly into the Thighes. For

1. This Pare gives a branch to the fleshy parts of the Midriff; and then provides for the Muscles of the Belly and Loyns.

2. It affords branches to some of the Muscles of the Thigh and Leg, and as many suppose, a branch to the Spermatick Vessels.

3. It goes to the Knee and its Skin, and part accompanies the Saphæna, and part goes to the Muscles which rest upon the Loyns.

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4. Among the Lumbal ones, it is the greatest, proceeding to the fore Muscles of the Thigh and Leg, as far as to the Knee.

5. It passes through the hole, which is betwixt the Hip-bone, the Share and Flank bones, and bestows branches upon some of the Muscles of the Thigh, Yard, neck of the Womb and Bladder.

But the greatest branches go from these three parts, unto the Thighs as shal be said in the following Chapter.

CHAP. V.

Of the Nerves which proceed from the Marrow of Os sacrum, and of the Nerves of the whole Foot.

OUt of the *spinal Marrow* contained in the *Os sacrum*, there arises five pare of Nerves, or as some reckon them six pare, out of the four uppermost of which, and the three lowest of the Loyns, arise the *crural Nerves*, descending between the Feet, which being in their Rise joyned like a little Net, do soon after sprinkle three branches from themselves, as shall be said by and by touching the Nerves of the Feet.

Now the *first pare* of Nerves of *Os sacrum*, is divided like the Lumbal Nerves, into a foremore and hindermore branch. But the five following Pares otherwise. For before they go out, they are on each side double, and on each side one Nerve goes into the fore parts, another into the hinder parts. The hindermore branches are disseminated like the hinder Lumbals, viz, into the hindermore neighbouring parts.

The three foremore which are uppermost, do go into the *Thigh*, the two lower to the Muscles of the Fundament and Bladder; and some to the Interfœmineum and Scrotum.

The Nerve Sine pari.

Moreover, the end of the Marrow of the Back, doth produce *only one* branch out of it self which is therfore termed *Sine pari*, without a Mate or fellow; yet somtimes it hath a fellow. It spends it self into the Skin, between the Buttocks and the Fundament, and into certain Muscles of the Thigh.

Now follow the *Nerves which go into the Thigh*, which before were said to be *four* in number.

The *first and third* are shorter, and reach only to the Thigh, the *second* is longer, and goes also to the Leg, the *fourth* is longest of all.

The first being made up of the third and fourth pares of the Loyns, descending to the small Trochanter, spends it self into the Skin and Muscles of the Thigh, and some of the Leg, and is *ended* above the Knee.

The *second* arising from the same place, descends with the Vein and Artery to the Thigh through the Groyns, it goes to the foremore Muscles of the Thigh, and is spread about the Knee. But it sends a remarkable branch inwardly with the Saphæna to the Ankle.

The *third arises* in the Articulation of the fourth and fift Vertebra, passes through the hole of *Os pubis*, to some upper Muscles of the Thigh and Yard, arising out of the *Os pubis*; and to the Skin of the Thigh in the Groyn.

The *fourth* is the thickest, longest, hardest and driest in the whole body, made up of four pare of the *Os sacrum*; it furnishes the Skin of the Thigh, and certain Muscles thereof, as also of the Leg and Foot. I have somtimes observed this to have a double rise, and a double progress, the one *External* the other *Internal*.

But that same great Trunk under the Ham, is divided into an external and an internal Branch.

The *external* goes to the Ham, the outside of the Foot, the *Musculi peronæi*, and the outer Ankle.

The *Internal* and greater goes along the Leg to the Muscles of the Feet and Toes; the inner Ankle, the great Toe and sole of the Foot: and bestows two twigs upon each Toe.

All the Nerves therefore well-neer, which go into the whole Leg and Foot, do arise from the only greatest crural Nerve.

THE

THE Fourth and last Manual OF THE BONES And also of the Gristles and Ligaments Answering the FOURTH BOOK Of the Limbs.

The reason of the Authors Method. Why he treats last of the Bones.

IN the last place, I shall briefly (as I have done other things) explain the Doctrine of the Bones.

In the last place, I say, because when all things else are removed and separated, then only the *Bones* come in view, and are subject to examination. The most diligent *Riolanus* treats in two places of his Enchiridion, of the Bones, once as they appear in the dead Carkas, when the Muscles are cut off, and again as they are dried in a Skeleton. But this Ostentation is superfluous in a compendium. For by the same reason we should make a new Anatomical discourse, of the Veins, Arteries, Nerves, Guts, Stomach, Womb, and other Parts taken out, and dried, and commonly hung up for shew in the Anatmoical Theatres. There is no use of the latter Doctrine of the Bones, unless to help the Memory, nor is it perfectly understood without the former. And therefore other Anatomists, with the parts demonstrate the Bones lying beneath them, in the dead body. I shal therefore only busie my self with the first, and therewith.

Joyn the Doctrine of *Gristles* and *Ligaments*.

Why he treats of the Gristles and Ligaments with the Bones.

1. Because of the similitude of their substance: for these three similar parts are very neer of kin, A *Bone*, a *Gristle*, and a *Ligament*, so that they seem to differ only gradually in respect of more and less one from another. For a *Bone* is the hardest, a *Gristle*, a little softer, yet so as that it may turn to a Bone, as we see in the tender Bones of Infants, which at first were gristy. A *Ligament* is yet softer than a Gristle, which also it self somtimes turns to a Bone, as in decrepit Persons. Hence many attribute the same matter to a Bone, a Gristle, a Ligament, yea and a Tendon.

2. Because of the Nearness of Place; for a Bone, a Gristle, and a Ligament do for the most part accompany one another, and are found joyned together. For the Bones are tied with the Ligaments, and where they are tied, they are covered about their Heads, with a Gristly Crust or Cover.

CHAP. I.

Of the Bones in General.

THE Nature of the Bones is easily known, if we shal but orderly propound their *Causes* and *Accidents* or *Adjuncts*.

The *Matter out of which* the Bones are bred in the Womb, according to *Hippocrates*, is an earthy Excrement, with Fat and Moisture added thereto. *Aristotle* also calls it *Excrementum seminale*, an excrement of the Seed. *Galen* saies it is the thicker and harder part of the Seed dried.

Now some Bones are *perfectly* generated in the Womb, as those in the Ear which serve the Sense of Hearing, being the smallest in the whole body; others *imperfectly*, as the Teeth and all the rest of the Bones, in which at first somwhat is wanting, either a process, or an Appendix. &c.

Moreover

Moreover, all other Bones save the Teeth have a certain determination of their growth: but the Teeth grow continually, for if one Tooth be removed, that just against it grows longer: which Nature therefore ordained, because they are alwaies wearing through grinding and chewing the Meat.

Whether the Marrow be the Nutriment of the Bones.

Their remote nutritive Matter, is thought to be the thicker and more earthy part of the Blood, and that which is as it were excrementitious, flowing in through the Veins into the Marrow, where in the Caverns of the Bones it may be digested, for *Platerus* denies that the Bones have Arteries, wherein *Spigelius* contradicts him: if there be Veins, there will doubtless be Arteries, which are as inconspicuous to the sight as the Veins are. Hence it is, that in the Cavities of the Bones of Animals newly brought forth, the Marrow is as yet bloody.

The *Immediate nutritive Matter* of the *hollowed* Bones, according to *Hippocrates* and *Galen*, is the Marrow contained in the said Bones (who are contradicted by *Aristotle* and other Peripetaticks, who will have the Marrow to be rather the excrement of the Bones) as in Gristles that same snotty matter which lies round about them, is their immediate nutritive Matter; and in Ligaments, Membranes and Nerves, that same clammy humor shed in amongst them.

Of the *solid Bones* not hollowed, the immediate Nutritive matter, is thick Blood sent in through the pores; because 1. Being broken they are joyned with a Callus, bred of the Remainders of the alimentary Blood. 2. They are liable to Imposthumation in their Substance, the superfluities of the nourishment putrifying in the pores. *Hofman* allows that they are nourished with Blood contained in the Marrow, and that the Marrow serves the Blood, by carrying the solid part.

The *Efficient* is the *Vis ossifica*, or Bone-making faculty, or the innate faculty, acting by the Assistance of Heat.

The *Form* of a Bone is the Soul, as of the whole, and in the next place the *ratio formalis* whereby a Bone is a Bone and no other thing, 2. *de Gen. Anim. cap.* 1. And therefore the Bones of dead persons are not properly but equivocally Bones. The Accidents or Adjuncts of Bones, are their sundry Figures, Solidity, Strength, &c. of which hereafter.

The *End* or Use of the Bones, is,

1. To be the Foundations and Supporters of the whole Body, like Pillars or Foundations in Houses.

2. To be as a Safeguard for some parts, as the Skull safeguards the Brain.

Why creeping things cannot go.

3. To serve for going, as is apparent in the Thighes and Legs. and therefore Serpents, Worms and other Creepers, which have no Legs, cannot go, but are forced to crawl.

4. There are some private uses of divers Bones, of which in the special History of Bones.

5. Certain Medicinal Uses there are of Bones. Their Pouder cures a Cancer, Fevers, any Fluxes. Their Oyl is good for the Gout, the Magistery of a Mans Skull is good against the Falling-sickness, as also the triangular Bones of the Occiput, &c.

The *Situation* of the Bones is deep, because they are the Foundations and Upholders of the Body.

They vary in *Magnitude* according to the variety of their Utilities. *Great* are the Bones of the Leg, Thigh, Arm, Shoulder, &c. *Small* those of the *Ear* serving for *Hearing*, the *Sesamoidean* Bones, the *Teeth*, the *Wrist-bones*, &c.

Why many Bones in a living Creature.

They are many in number and not one only, because of the variety of motions; and lest that one being hurt, all should be hurt.

Now a monstrous thing it is for a Child to be born without Bones, such an one as *Hippocrates* speaks of, being a Boy, four fingers big, but not long-liv'd the like to which *Forestus* also saw.

The Number of all the Bones of the Body, is not the same in all Persons. For in Children they are more, which by degrees grow together and become fewer. Others may number the Epiphysis by themselves as distinct Bones, and so make a mighty number. Others may omit the Sesamoidean and other small Bones, or such as are seldom found, as in the Carotick Arteries: and so doth *Archangelus* who reckons but two hundred forty nine: others make commonly three hundred and four. Others as many as there are daies in the year.

They vary in *Figure* some are round, others flat, some sharp, others blunt, &c. as shal be shewed when we come to speak severally of the particulars.

The *Colour* in such as are naturally constituted, is white, mixt with a very little red.

They are all of them externally *inclosed* (not internally) with the Periostium, excepting the Teeth, sesamoidean Bones, and the sides of the other Bones where they are mutually joyned one to another. And the Periostium is exquisitely sensible: but the Bones themselves want the sense of Feeling, excepting the Teeth, to whom we may attribute some Sense, seeing they feel exceeding cold Air or Water, yea with their Ends: especially when the Teeth are on Edge, before it reach to the little Membranes and Nerves, by help wherof they are thought to Feel.

The Periostium feels, but not the Bones. The Sense of the Teeth.

The *Connexion* of the Bones is various. But the mutual and artificial hanging together of all the Bones is by the Greeks cal'd Skeleton, as if you would say a dried Carcass from *Skellein* to drie. Being compacted partly with the natural Ligaments dried with the Bones, & partly with artificial ones, somtimes bolt upright, otherwhiles in the posture of sitting; which doth not properly belong to Anatomy, but the other Natural Osteology, framed by Nature, and adorned with its own moist Ligaments.

And this natural Cohærence or Connexion, according to *Galen*, is made either *kat' árthron* by way of Joynting; or *katà symphusin*, by way of growing together.

He makes *Arthron* a Joynt to be double; viz. *Diarthrosis* or by way of Diarticulation or joynting, such as are *Enárthrosis*, *Arthrodia* and *Gigglumos*: or *Synarthrosis*, such as he reckons *Suture*, *Harmonie* and *Gomphosis*

Moreover *Symphysis* or growing together, is said to be with or without a Medium.

But I shall thus divide the Connexions of the Bones.

The Bones are fastned together either by *Articulation* or Joynting; or by *Symphysis* or growing together.

Articulation or *Joynting* is with motion, and that either *obscure* (which others cal neuter or doubtful Articulation) as that of the Ribs with the Vertebræ, also of the Bones of the Wrist and Pedium; or *evident* loose and manifest, and it is called

Diarthrosis, of which there are three sorts:

I. *Enarthrosis* Inarticulation, which is when there is a great quantity both of the Cavity of the Bone receiving, and of the Head of the Bone which is received: as in the Articulation of the Thigh with the Huckle-bone.

II. *Arthrodia*, is where the Cavity receiving is superficial, and the Head received flat: as is that of the lower Jaw with the Bone of the Temples.

III. *Gigglumos*, when the same Bone both receives, so that contiguous bones do mutually enter one into another. And it is done three manner of waies:

1. When the same bone is received by one bone which receives the same again mutually; as we see in the Articulation of the Shoulder-bone with the Cubit.

2. When one bone receives and is received of another, as in the Vertebræ. For the Vertebra being placed in the middle, receives the upper and is received by the lower.

3. In

3. In manner of a wheel, as that of the ſecond Vertebra of the Neck with the firſt; where upon the Axel-tree as it were of one Vertebra, another is turned and wheeled about,

By *Sumphuſis* or growing together, Bones are faſtned, when the Connexion is without motion, and two Bones do only touch one another, or approach mutually one to another, as in the former.

And this growing together is either without a medium or with it.

Without a Medium:

1. *Rhaphé* a Suture as in the Skul.

2. *Harmonia*, which is a joyning of Bones by a ſingle Line, ſtreight, oblique, or circular: as in bones of the upper Jaw and the Noſe. And ſo all Epiphyſes in a manner are joyned.

3. *Gomphoſis* that is to ſay Nailing, when one Bone is faſtned into another as a Nail in a Poſt, as the Teeth in the Jaw-bones.

Theſe three ſorts *Galen* and others following him, have comprehended under *Synarthroſis* as the Genus or kind. But they are out: becauſe Bones thus joyned have no motion. yet peradventure they may ſome waies pertain to *Synarthroſis*, becauſe of the firmneſs they afford to the parts of the body.

With a Medium there is alſo a threefold growing together of the Bones, by reaſon of a threefold body coming between as the Medium:

1. A *Griſtle* and the conjunction is called *Synchondroſis*. as in the Bones of the lower Jaw, and the Share-bones.

2. A *Ligament* and it is termed *Sunneuroſis*, as is ſeen in the Union of the Huckle-bone with the Thigh-bone.

3. *Fleſh* or a Muſcle, and it is called *Suſſarcoſis*, as in the *Os hyoides* with the *Scapula*.

The *Subſtance* of the Bones is hard, but not with drineſs in an healthy State, but with a ſhining fattineſs. to which others joyn an acid or ſharp ſpirit and a volatil Salt, in which regard they eaſily take fire and are burnt inſtead of Wood, as the *Rogus* of the Romans or their Funeral-fires did witneſs [*and our Engliſh Bonefires*, for anciently (and yet in the North) they kept their Bones of Beef &c. til an occaſion of Triumph, and then brought them out for joy to make Bone-fires] otherwiſe they would eaſily be broken, as we ſee in calcined Bones, and in that old Woman, whoſe Members would break at the leaſt touch, as *Nic. Fontanus* relates in his Obſervations. And *Galen* tels of ſome bones that would turn to Sand and Duſt, like rotten wood, which is the effect of drineſs.

A Bonefire properly what.

The Leſs this *Hardneſs* of the Bones is, the better do broken bones grow together and unite.

But in Perſons that are come to years, they do not truly grow together, nor are regenerated, but are as it were glewed together, by the coming between of another ſubſtance like Glue, which they term *Callus*. *Galen* calls it *Porus*. Now a *Callus* ſomtimes happens beſide the Intent of Nature, through overgreat plenty of Aliment and bad Nutrition: viz. when by a boney callus, the three upper Vertebra's of the Neck are ſo glewed together as they ſeem to be but one bone: or when the firſt Vertebra is glewed to the Skul; and ſuch perſons cannot expreſs their conſent or diſſent, by moving their Head forwards or backwards as the manner is.

There is a greater hardneſs in ſome Bones than in others, as the Thigh, &c. But other Bones are ſofter, as of the *Os Spongioſum*, the laſt bones of the Fingers &c. *Fernelius*, *Rnellius*, *Hollerius* have found all the bones ſo preternaturally ſoft, that they might be bowed like Wax, and that chiefly by the venereal Pox, witneſs *M. Donatus*. The *Cartilago inſiformis* proves ſomtimes ſo ſoft and flaggie, that it falls, of which ſee *Codronchius*.

The parts of the Bones are ſolid or Hollow, yet *Plinie* tels us, that there were ſome that lived whoſe bones were ſolid, without any hollowneſs, who are by him called *Cornei*, and that ſuch perſons are known, in that they never ſweat nor thirſt. which *Salinus* avouches of one *Lyddanus* a Syracuſian. But both theſe Authors can ſomtimes drop leaſings.

The *Cavities* are either *within* where the Marrow is, which cavities nevertheleſs are not every where conſpicuous; or *without* at the *joyntings*; which hollowneſſes if they are deep, they are called *Cotúlai* or *Cotulides* (not *Cotuledones*) alſo *Acetabula*, Sawcers. *Cotyle* was among the Ancients, a meaſure of Liquors, containing as much as their *Hemina*; alſo a kind of Drinking Cup, as ſome ſuppoſe. If the Cavities are *ſhallow*, they are called *Glénai* and *Glenoeideis* from the form of the Eyes hollowneſs when the Eye-lids are ſhut.

The ſolid parts of the Bones are three.

The *firſt* and principal is called *Os*, and is the hardeſt part, ſeated commonly in the middle.

The *ſecond* is by the Greeks called *Apophyſis*, alſo they term it *Probolen* and *Ecphúſeſin* &c. the Latines call it *Proceſſus*, *Productio*, *Projectura*, *Extuberantia* &c. It is a part of a bone, not only touching as *Epiphuſis*, but continued bunching out beyond the plain ſurface of the Bone: ſuch as many are in the Vertebra's of the Back, alſo in the lower Jaw-bone.

Its chief *Uſe* is for the original and Inſertion of parts, as Muſcles.

The *third* is *Epiphuſis*, or *Appendix*, *Adnaſcentia*, *Additamentum*; being a bone growing upon a bone, by a ſimple and immediate Contact, though not with ſo very plain a Surface, but a little mutual Ingreſs of Heads and Hollows, like *Ginglumus*, though without motion.

The Subſtance of the *Epiphyſes* is rare and looſe, being at firſt for the moſt part griſtly; but in perſons grown to years, it is hardned, and turns to a bone: yea in elderly perſons, the *Epiphyſis* is ſo united to the bone, as if they were but one contined bone,

At the Ends of the *Epiphyſis* a Griſtle is placed.

But all Bones have not theſe *Epiphuſes* growing to them: yet there are divers of them; as in the *Scapula*, on the Bones of the *Tibia* and the *Fibula*, viz. on each ſide, at the Tree and Foot &c. Alſo the Tooth of the ſecond Vertebra, the *Rotator magnus*, the *Appendices Styloydes*, are *Epiphyſes*.

The *Uſe* of *Epiphyſes*.

1. In ſoft bones they are inſtead of covers, that the Marrow may not run out.

2. They ſerve for firmneſs, for that Baſis is moſt firm which is broadeſt and largeſt.

3. That from them Ligaments may ariſe.

4. According to *Pavius*, that they might be as it were an intermediate matter, to be inſerted betwixt a bone and Ligaments, as the Membranes betwixt the Brain and Skull.

The *Apophyſis* are in ſome places called *Capita* Heads; in other places, *Cervices* Necks; in other places *Tubercula* bunches; in ſome place *Spinæ* thorns; in other places *Mucrones* ſharp points. But the parts which at the round of the Cavities, ſtick out and hang over like Lips, are called *Supercilia* Brows, and *Labra* Lips.

Chap. II.
Of Griſtles in General.

Griſtles next to Bones are the hardeſt ſimilar parts, and almoſt juſt of the ſame Nature with Bones, for ſuch Beaſts as have no Bones, have Griſtles inſtead of Bones according to *Ariſtotle*.

But they differ, becauſe they are ſofter than Bones, though harder than Ligaments: and though very many Griſtles are in proceſs of time turn'd into Bones [as *Car-*

dan ſhews by the example of a Thief of *Milaine*, whoſe weſand was become boney. Alſo many Sceletons of my Kinſman *Henry Fuirenus* declare, that the Cartilago ſcutiformis, or ſheid-faſhion'd Griſtle, is changed into the hard ſubſtance of a Bone, which I alſo have obſerved in Diſſections] yet all Griſtles are not ſo, as the Enſiformis, that of the Share, of the Spines of the Back, of the Noſtrils and Ears: which nevertheleſs ſomtime, in aged perſons are turned into Bones. Moreover a Griſtle hath no Marrow, no Cavities nor Caverns.

The *Efficient* is the *Griſtl-making power* or faculty.

The *Matter* according to *Ariſtotle* is the ſame with that of the Bones, from wich he wil have them to differ only gradually. According to *Galen* it is an earthy but withall moiſt part of the Seed, partly clammy and glewiſh, partly fat: but more clammy than fat.

Its *Uſe* 1. Is principally to render motion more eaſie and laſting in the Joynts, whiles it anoynts the parts of the Bones, leaſt by mutual rubbing one againſt another, they ſhould wear and fret. Hence in ſome Joynts are found Griſtles which cruſt over two bones joyned together.

2. To defend the parts from external injuries. For they are not eaſily bruiſed and broken, becauſe they are hard and not friable, nor are they eaſily cut and ſqueezed as the ſoft and fleſhy parts. Hence the extream parts of the Noſe are griſtly. Hence Griſtles are joyned to the Breaſtbone and Ribs, to defend the Heart and Lungs, and the Griſtle *Enſiformis*, to defend the Midriff and the mouth of the Stomach.

3. To make ſuch a Connexion of the Bones as is termed *Sunchondroſis*.

4. To ſhape parts prominent or hollow; as appears in the Ears, Larynx and Weſand.

5. To fill up hollowneſſes, eſpecially in the Joynts, as is ſeen in the Knee.

6. To ſerve for a cover, as in the *Epiglottis*.

7. To be as an underpropper to ſuſtain ſomwhat, as the Griſtles of the Eyelids bear the Hairs.

Their *Situation* is various, for Griſtles are found in ſundry parts, in the Eye-lids, Noſe, Ear, Larynx, Wezand, Spine, Cheſt, Ear-lets, of all and every of which in their places.

Their *Magnitude* alſo varies: ſo alſo

Their *Figure* is divers, as ring-faſhion'd, Sheild-ſhap'd, Sword-like, &c.

As to their *Connexion*. Some *Griſtles* conſtitute parts of themſelves, as that of the Noſe, *Xyphoidis*, the *Coccyx*: others grow to bones, which knit them together, either without any other medium, as in the Share and Breaſtbones, or by common Ligaments coming between, as in the Connexion by *Diárthroſis*.

In *Subſtance*, ſome are harder, as thoſe which in time become boney; others are ſofter, faſtning the Joynts, and reſembling the Nature in a manner of Ligaments, and are therefore called *Chondro-ſyndeſmoi*, *Griſtly Ligaments*.

Now though their Subſtance be hard, yet it is flexible and tough becauſe leſs cold and dry than a bone, and becauſe compaſſed with a ſnotty matter.

And this Subſtance of theirs is void of ſenſe; becauſe it hath no acquaintance with Nerves nor Membranes. Nor was it requiſite that it ſhould feel, leaſt in motion when the Griſtles rub and ſtrike one againſt another, pain ſhould be cauſed.

In other things they agree with Bones.

Chap. III.
Of Ligaments in General.

Ligamentum a Band or Tie, is by the Greeks called *Sündeſmos*. The Ancients, as *Hippocrates*, *Ariſtotle* and *Galen* ſomwhere, call it *Nervum* and *Nervum colligatum* a Nerve, and a twiſted Nerve or Nerve tied together; becauſe in ſhape and colour it counterfets a Nerve: and otherwiſe the term Ligament, may in a large ſignification be applied to any part, which faſtens divers parts together. Alſo *Galen* calls the beginning of a Muſcle *Ligamentum*, part whereof is thought to turn to a Tendon. All theſe are improper acceptations. I ſhall now decipher a Ligament properly ſo called.

Its *Efficient* is the Ligament-making Power.

Its *Matter* is a clammy roaping part of the Seed.

Its *Uſe* is, like a cord to bind together the parts of the body, eſpecially the Bones, and ſo to keep them together, in the Head, Cheſt, Back, and Limbs, that they may not be diſlocated or diſpointed.

Becauſe of its moſt ſtrong cleaving thereunto, a Ligament is ſaid to ariſe (though it be indeed made of the Seed) from the Bone primarily, ſomtimes from a Griſtle, griſtly bone or Membrane: and its ſaid to be *inſerted* into a Bone, Griſtle, Muſcle, or ſome part. Or if you would rather have it ſo; Ligaments grow among the Bones, or in the Bones.

Their *Situation*. Some are without among the Bones, as the griſly Ligaments ſo called, which are thick and commonly round: others are wound externally about the bones which are thin and membranous.

As to *Figure*: ſome are broader which Anatomiſts term membranous Ligaments, as hath been ſaid; others are longer, which are called Nervous Ligaments. And they call them ſo becauſe of their reſemblance, not as if a Ligament were truly membranous or nervous. So they are called membranous, which being broad and thin do compaſs the Joynts, alſo which are wrapt about Tendons and Muſcles.

Its *Subſtance* is ſolid, white, bloodleſs, ſofter than a Griſtle, harder than Nerves and Membranes: for it is as it were of a middle Nature betwixt a Griſtle and a Nerve.

It is without Cavity, Senſe or Motion. It was to be without Senſe, leaſt it ſhould be alwaies pained in Motions; when as the Ligaments are made ſomtimes longer and ſhorter, that is to ſay, are contracted and extended. Some nevertheleſs wil have membranous Ligaments to feel, but they muſt grant it to be ſo, by means of membranes and not of their own proper ſubſtance.

For this ſubſtance of theirs is as *Galen* tels us diviſible into fibres viſible to the ſight, which experience alſo confirms.

Now this Subſtance is in ſome places *ſofter* and more membranous than in others, as in all Ligaments wel-neer, which go round about the Joynts; and among theſe, it is ſofter about the Joynt of the Shoulder, than about that of the Hip; and yet ſofter where it goes about the interjoyntings of the fingers. But in other places the ſubſtance is harder and as it were in part griſtly, and therefore they are in ſuch places termed griſtly Ligaments; and they are ſuch as lie concealed among the Bones, as that which goes from the Head of the Thigh, into the Hip-joynt.

Chap. IV.
Of the Skull in General.

The diviſion of the Skeleton.

WE divide all the *Bones* of the Skeleton into the HEAD, TRUNK, and LIMBS; and them into the *Arms* & *Legs*.

The whole ſtructure of the Bones of the Head is termed CRANIUM the Skul, becauſe it is as it were *Crános* an Helmet; ſome term it *Calva* and *Calvaria*.

Its *Situation* and *Magnitude* follow the Brain and correſpond thereunto.

Its *Figure* is natural or non-natural and depraved.

Its *natural* figure is *round*, that it may hold the more, yet a little longiſh towards the fore and hindparts, where it branches forth, that it may contain the Brain and Brain-

let;

let; on the sides it is flatted, but more towards the fore-parts; and therefore the hind-part of the Head is of greater capacity than the forepart: of which *Albovinus* King of the Longbeards or Lombards made a Drinking Cup for Festival daies, as *Diaconus* relates in his History.

Depraved shapes of the Head eleven in number.

The *depraved* and non-natural Figure thereof is manifold.

1. When the foremore protuberancie of the Head is wanting; and such persons are counted fooliſh and mad, for want of Brain, which ought to be most plentiful in the forepart of the Head.

2. When the Hinder Protuberancy or bunching forth is wanting.

3. When both are wantings so that the Head is round as a Ball, such as the Heads of the Turks and Greenlanders are thought to be. And these three depraved figures *Hippocrates* doth acknowledg.

4. The fourth Figure *Galen* adds, which he conceives may be imagined but not really found, when the length is changed into breadth. But *Vesalius* saies he saw such an one at *Venice*, and at *Bononia*.

5. The fift way may be added also out of *Hippocrates*, an acuminated or oval Figure, when the Head rises up like a Sugar-loaf: which shape in some Nations *Hippocrates* tels us had a great reputation of Gentility, and may be formed by Midwives, when they swathe the Childs Head into such a shape and so preserve it; and at last Nature transfers such kind of Heads from Parents to Children. The same *Hippocrates* in his *Epidemicks*, brings in two kinds of thus shap'd Heads, one with the strength of the parts, the other with weakness of the said parts. And such a figure of Heads, is at this day more frequent in some Countries than in others.

But now I wil add other figures which I have observed in many Skuls, especially in *Italy*.

Other shapes of the Head observed by the Author.

6. When the right side branches out.

7. When the left side sticks out.

8. When the right part of that bunchiness which naturally should be before is wanting, and the left sticks out very much, in some more. others less.

9. When the left side of the said Protuberancy is wanting, and the right sticks out more than ordinary.

10. When the right part of the Hinder Prominency is away.

11. When the left part of the said hinder Protuberancy is away.

And thus I make *twelve shapes* of the Head in all, one *natural* and eleven *depraved*,

The *Substance* of the Skul is boney, to secure the soft Brain. But in Children new born it is softer then ordinary, and in some places cartilaginous and membranous, especially about the Sutures, and most of all in the middle and upper region of the Head: and all these for the making the Birth more easie, that it might give a little way when it is pressed. But the Substance of the Skul is.

1. Thick, not thin, that it may more strongly resist external injuries.

2. Rare not compact. 1. Least it should weigh too much. 2. That it might contain Juyce for nourishment, 3. That vapors may exhale.

Now this Substance of the Skul doth consist as it were of a double boord or plate. It is seldom simple and single without a *Meditullium* or middle matter, as I found it in the Dissection of a certain person, and seldomer hath it three boords, But for the most part two as hath been said. some call them *Diploas*, the outer whereof being unhurt, the inner may be hurt. And each of these plates is commonly polished within and without, smooth and thick. Hence it appears how thick the Skul is, seeing it is every where in a manner double.

I say in a manner or wel-neer, which others do not observe: for in some places the Skul is single, thin and transparent. without any distance of plates. And therefore some Chirurgeons are deceived, who in taking away the first Plate do think they must so long cut and prick, til blood comes out. The external Plate is somtimes eaten off by the Venereal Disease, and somtimes it sprouts forth Gums by force of the said Disease.

The Error of Chirurgeons

But the rarity or light composure of the Skul appears from that *middle substance* between each Plate, which they call *meditullium*. This Substance, I say, is rare or light, lax, and receives little Veins: which also *Hippocrates* knew, who therefore warns us that the Skul is very easily inflamed, and therefore when the Trepan is used, the Iron must divers times be dipt in Milk and Water.

The *Surface* of the Skul, is external or internal.

The *upper External* is smooth and even; the lower or Basis, is rough and uneven, by reason of sundry Appendices and Processes.

The *upper Internal* is hollow, smooth; save that it hath the Marks of Veins, and certain Cavities, wherein the *dura mater* grows: the lower is very uneven by reason of divers protuberancies.

And every where there are frequent *holes* in the Skull, very small and placed without order, through which small Veins and Arteries pass, to the inner Cavity of the Bones, and the *dura Menynx*. But somtimes they are not to be found.

At length, that we may come to the parts of the Skull, we must know that the Skul doth not consist of one only Bone, least by one wound the whole Skul should be broken in pieces; but of divers: which are fastned together by the Sutures, of which in the following Chapter.

And some are Bones of the Skull, others of the Jaw.

The *Bones* of the *Skull* in persons grown to ripe years are *eight*, whereof two *are common* to the Skul, with the upper Jaw-bone, viz. the *cundiforme* and the *spongiosum*. But there are *six proper* bones, which make up the Skul it self: One of the *Forehead* (in new born Children two) two of the Forepart of the Head, one of the *Hind-part* (in an Infant four) two of the *Temples*. And there lie hid in the Auditory passages, other *six* bones, on each side three little ones: the *Hammer*, the *Anvil*, and the *Stirrup*, to which a fourth is added called *Orbiculare*.

And thus there are perpetually in the *Skull fourteen* or sixteen Bones.

The Use of the Skul:

1. To be the Mansion and Bulwork of the Brain, which of it self is soft.

2. That through it Vapors may pass.

To the former use, its thickness and hardness is subservient; to the latter its rarity and Sutures.

On the Skul of a Man somtimes *Horns* grow, one whiles soft, another while hard like Rams Horns; sometimes fixed to the Skul, otherwhiles to the Skin, and they proceed from a thick, clammy and melancholick humor. There are examples hereof in *Paræus*, *Thuanus*, *Hildanus*, *Renodæus*, *Zacutus*, *Severinus*, and others; I also saw two horns, one at *Padua* in a Nunn, another at *Purmerent* in *Holland* in an old Woman, which was sufficiently long and hard: I have discoursed of these Horns in my new Observations *de Unicornu*, of the Unicorn.

Chap. V.

Of the Sutures of the Skull.

A *Suture* is a sort of connexion resembling the putting together of two Saws, tooth within tooth, or the making up of a Garment of many torn patches.

Such Sutures there are many in a mans Head: for an Head is seldom found without any Suture, such as *Aristotle*

An Head without Sutures.

ſtotle ſaw, and at *Helmſtadt* and the Monaſtery of *Heilbrun* in *France* ſuch an one is ſhewed (as a Rarity) and is every where to be met with.

And ſuch perſons have not their Heads ſo liable to external injuries, but very much to inward Infirmities, becauſe tranſpiration is thereby made more difficult. By which diſtinction, *Falopius* and *Columbus* do reconcile *Celſus* and *Robertus Conſtantinus*, the former of whom wrote, that the Head which had no Sutures was moſt liable to ſickneſs, the latter that the Head without Sutures was more ſubject.

Somtimes through Age and Drineſs, the Sutures do ſo grow together in aged perſons, that they are ſcarce to be ſeen; whereas they are in the mean ſeaſon, more viſible in young perſons. Somtimes the coronal ſuture is only ſeen obliterated; but the temporal do hardly vaniſh, except all the other be firſt defaced.

The Error of Ariſtotle.

The *Number* and *Situation* of the Sutures, is the ſame in a Woman and in a Man, contrary to what *Ariſtotle* thought; nor doth it vary in reſpect of figures, as *Hippocrates* and *Galen* would have it, unleſs very rarely. For *M. A. Severinus* obſerved between the ſaggiteal and Lambda-faſhion'd ſuture, another over and above of a triangular ſhape, and neer the end of the ſaid Sutures in another Skul, a new oval Suture.

Moreover, the Sutures of the Head of a certain Fool, did vary in figure, which all ſtuck up with one Hillock as it were. which I ſaw in three Epileptick Children at *Naples*, eſpecially in the coronal Suture, which did ſuggeſt a new Cauſe and Cure of the Epilepſie or Falling-ſickneſs.

The *Sutures* which knit the Bones of the Skul, are ſome of them called true and proper, others falſe and Baſtard Sutures.

They are termed *true*, which meet together like the teeth of Combs, or like Saws put together, which I have ſomtimes ſeen after Contuſion movable, which alſo in moſt Skuls that are over dried in the Earth is common. They are alſo looſe in Children, and therefore they open in Hydrocephalic or Water-headed Children, as I ſaw in a Boy at *Hafnia*, like to that which *Severinus* pictures out in his Treatiſe of Impoſthumes, and *Donatus* deſcribes.

The *baſtard* Sutures are joyned like Scales and Tiles on an houſe-top, and therefore they are termed *Squamoſæ conglutinationes*, Scaley-conjunctions, and may rather be termed joynings, ſeeing they are more like to an Harmonia then a Suture.

There are three *true* ones.

The coronal Suture why ſo called.

1. Is the foremore, and is called *Coronalis*. 1. Becauſe the Ancients wore Crowns on that part of their Heads. 2. Becauſe it hath ſome reſemblance to a Crown or Circle:

For from the Temples it aſcends on both ſides, athwart, to the top of the Head. The Arabians call this ſuture *Arcualis* and *Puppis*.

Its *Uſe* is to joyn the Fore-head bone with the bones of the Hinder-head, and to diſtinguiſh them therefrom. The place of the coronal Suture is found out in a living perſon, either by carrying the hand upwards from the Wriſt along the Noſe, or by drawing a Thred out from Ear to Ear, and another croſs the ſame from the end of the Noſe.

2. That which is oppoſite to this, is behind and in the *Occiput* or Hinder-head. 'Tis called *Lamdoeidès* the Lamda-ſhap'd, from the Greek letter Λ. ſome call it *hupſiloïdes* from the letter *upſilon*, alſo *proræ ſutura*.

This aſcends obliquely, from the Baſe of the Hinder-head, to each Ear, grows into an Angle. Somtimes when the Hinder-head is large or otherwiſe, 'tis divided by a tranſverſe ſuture, ſimple, or double: ſomtimes there is a double triple Suture as if a greater triangle did contain one or two leſſer Triangles within the ſame: where the Bones ſo comprehended, are termed *oſſicula triangularia*, the little three-cornerd bones, commended, in the Falling-ſickneſs.

The triangular Bones of the Skul.

Beſides theſe triangular bones, *Olaus Worm* a rare man, found others in the Lambda-like Suture, which perforated both the Boards of the Skull, obſerved as yet by very few. Three for the moſt part on the right, as many on the left ſide, differing in magnitude, figure and ſituation, which alſo are accurately diſcerned and diſtinguiſhed in Infants. The *loweſt* is ſeen at the *Proceſſus mammillares*, the *middlemoſt* a little higher, ſcarce half a Fingers breadth, the *third* a little further diſtinct from the ſecond. *Pavius* found only two like to theſe, circumſcribed with their little Sutures or ſeams, which he doubts whether he ſhould refer them to the Bones of the *Occiput* or the Bregma.

In *Shape* they are Various, Triangular, Oblong, Oval. ſomtimes in living perſons I have obſerved them to grow ſo high, that I could Feel them with my Fingers, as if they had been Epiphyſis or ſomewhat growing upon the Bone.

All are *larger* on the left ſide, but the greateſt exceeds not the Nail of a Mans thumb.

They appear more diſtinct on the inner & Concave ſide of the Skul, than in the outward and convex, and therefore they are all more cleerly diſcern'd when the Skul is taken away,

We are nevertheleſs to obſerve that theſe bones of *Worm* do in divers Skuls vary, both in Number, Magnitude, Figure, Situation; ſo that ſomtimes there are four, ſomtimes two, and in a Right line only, ſomtimes in the very Juncture of the Sagittal with the Lambda-ſhap'd; ſometimes alſo in the Scaley temporal Sutures.

Their *Uſe*, I believe, is 1. That the Sutures being inlarged thereabouts, might afford a more free paſſage for Excrements.

2. That the Skul being made up of more bones, might be more ſafe in Blows and Contuſions.

The *Uſe* of this Lambda-like Suture, is to diſtinguiſh the bone of the *Occiput* or Hinder-head, from the bones of the Temples, and the forepart of the Head.

3. In the middle betwixt theſe two is the Suture termed *Sagittalis* or Arrow-ſhap'd, becauſe it runs in a ſtreight line all along the Head, like an Arrow, betwixt the Coronal and Lambda-ſhap'd Sutures.

Somtimes it proceeds through the middle of the Coronal Suture and the middeſt of the Fore-head, as far as to the Noſe, eſpecially in Infants: in ſome alſo it cuts part of the Bone of the *Occiput* or Hinder-head. I remember it hath been ſomtimes wanting.

This Suture is termed *Virgata* and *Recta*.

Its *Uſe* is to diſtinguiſh and joyn together the two bones of the *Sinciput* or Fore-part of the Head.

Why ſome Sutures are like Scales.

Thoſe two Suture are commonly called *Nendoſæ* or Baſtard-ſutures, which are wont to be called *Squamoſæ* Scalie, *Corticales* and *Temporales*, becauſe they circumſcribe the Bones of the Temples. Now this Connexion like Scales was neceſſary, becauſe the Temple-bones, being in the lower part very thick would have been to heavy, if they had not been made by little and little thinner in their upper part, and joyned to the bones of the *Sinciput* atenuated by little and little like Scales.

A great number of Sutures.

Now there are many ſpurious Sutures every where in the Skul, alſo many harmonies, where the bones are joyned together: in the Palate bone a peculiar Suture is ſeen.

The *Uſe* of the Sutures.

1. They ſerve for the free tranſpiration of fuliginous vapors. And therefore *Hippocrates* pronounces, that they have ſoundeſt Heads, who have moſt Sutures: and thoſe that have their Heads without Sutures, are troubled with

an

The FIGURE Explained.

TABLE I.

A. *A Portion of the Sagital Suture.*
B. *The Lambda-like Suture.*
C. *The Skull cut with a Saw.*
D. *The first Bone of* Worm, *on the left quarter.*
E. *The second.*
F. *The third.*
G. *The first of the right Quarter.*
H. *The second.*
I. *The third.*
K. *The great hole of the Skull.*
LL. *The mammillary productions.*

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an inveterate Head-ach. And *Galen* saw so great an Inflammation caused by over strait binding of the Head, whereby the Sutures were shut up, and the Excrements kept in, that the Patients Eyes came out of their holes.

II. That by them the *Dura mater* may be tied and held up, least it should squeez the inner parts of the Brain.

III. That the said *dura mater* might by them send out fibres to constitute the *Pericraneum* and the *Periosteum*.

IV. That Vessels may go in and out, to nourish and inliven the parts; which Vessels are by *Fallopius* cal'd *Venæ puppis*.

V. That one Bone being broken the others might remain whole. And therfore *Galen*, *Paulus*, *Guido* and *Fallopius*, denie that there can be any contrafissure or Countercleft, save in a solid Head without Sutures: *Hippocrates* writes the Contrary, and cals it a Misfortune, as also *Celsus* and others, and *Fallopius* himself, *Paræus* and *Pavius* relate examples, and before them *Soranus*, taking a similitude from a Glass Bottle, which oftentimes, being struck on the one side, is crakt on the opposite part.

VI. That Topical Medicines being outwardly applied, may more easily penetrate.

Chap. 6. *Of the proper Bones of the Skull in particular.*

THe *first Bone* is the Os FRONTIS, the Forehead bone, which some call *Coronale*, *Inverecundum*, *Os puppis*: which hath

A *Figure* imperfectly circular; more perfect where it is circumscribed with the Coronal Suture, more imperfect neer the Eyes.

Its *Substance* is thinner than that of the *Os occipitis* or Hinder-head bone, and thicker than the *Ossa sincipitis*, or bones of the foremore part of the Head.

It is twofold in Children new-born, distinguished by the sagittal Suture: also framed of a twofold Plate, an external and internal.

See Tab. 4. Fig. 1.

At the top of the Nose above the Eye-brows, there are large *Cavities* commonly two in number, between the two plates, sometimes cloathed with a green Membrane and separated, containing a certain soft and marrowish body. But these Cavities are not 1. In Children til they are a year old. 2. In such as have a flat and Saddle-face. 3. In such whose Fore-head is divided.

The said Cavities have *holes* which end into the wide spaces of the Nostrils: and another which ends into the Skul, above the *Septum* of the *Os spongiosum* to distinguish the Organs of Smelling.

The Use of these Cavities.

1. To make the Voyce Melodious and Sounding; because they are not in such who have a bad Speech.

2. Some conceive they serve for the Air to be elaborated in, to generate animal spirits.

3. That they may contain the Air which is drawn into the Nostrils and brings the smels of things along with it, from whence it passes leisurely to the Organs of Smelling, and to the Brain to alter the same, and reduce it to its natural State, when it is disordered. And therefore it is that many times an whole day together a smel is perceived in the top of the Nostrils.

4. Others suppose, they serve to collect Excrements, not only thick but watry, which being carried to the *Glandula lachrymalis*, do make Tears.

5. some conceive that the marrowy matter therein contained, doth pass through the hole of the greater Corner of the Eye, and moisten the Eye make it glib and slippery, that it may move the Eatier.

This Bone hath *Processes*: one at the greater Corner of the Eye, another at the lesser, to constitute the upper pare of the Eye-hole or Socket. There are also two cornerd *Eminencies* or risings on each side one, towards the Temples, which are termed Horns; by *Albucasis*, Dionysisci the *Author* of the Definitions and *Heliodorus* the Physitian; and if that boney Tumor be only on one side *Ingrassias* calls it *Dionysiscus*.

It hath three *holes*; one more inward of which before, which ends into the Skul: two outward, at the middle of the Eye-brows, for the thorough-fare, of the Nerves of the third Conjugation to the Forehead.

The *Second* and *Third* are the two *Bones* of the *Sinciput* or *Vertex*, which some call *Parietalia*, others *Arcualia*, *Nervalia*, *Rationis* or *Cogitationis*, of reason or thought: the Greeks *Brégmatos ostâ*, because the most moist and soft Brain, is placed under them.

In *Shape* they are four square and unequal.

Their *Substance* is more rare and infirm then of other Bones, because the Head in this part, wants very much evaporation: and therefore the Wounds of the *Sinciput* are deadly.

Why the wounds of the Sinciput are deadly.

The FIGURES Explained.

In this TABLE are preſented the Bones and Sutures of the Skul, as alſo the parts of both the Jaw-bones.

TABLE II

FIG. I.

AA. *The Coronal Suture.*
B. *A part of the ſagittal Suture.*
CC. *The ſcalie Suture of the Bones of the Temples.*
D. *The Os frontis, or Bone of the Fore-head.*
EE. *Proceſſes of the ſaid Bone, to the grater corner of the Eye.*
F. *Another proceſs to the leſſer corner.*
G. *An hole for the paſſage of Nerves expreſſed on one ſide.*
H. *Os Bregmatis.*
I. *The Bone of the Temples.*
K. *Its Appendix cal'd Styloides.*
L. *Its mammillary proceſs.*
M. *Another proceſs thereof, which makes the Os jugale.*
N. *The firſt bone of the lower Jaw according to our Author.*
O. *The ſecond Bone.*
P. *The hole of this Bone, neer which is the Caruncula Lachrymalis.*
QQ. *The third Bone of the upper Jaw.*
RR. *The fourth Bone thereof.*
S. *The Partition of the Noſtrils.*
T. *The lower Jaw-bone.*
u. *Its outer and leſſer hole, the greater is to be ſeen within.*
X. *The proceſs of that Jaw-bone, termed Corone.*
Z. *The other blunted Proceſs called Condilodes.*
αα. *The Dentes Inciſores or Cutting Teeth.*
ββ. *The Dog-teeth.*
δδδδ *The Grinders or Grinding-teeth, Molares.*

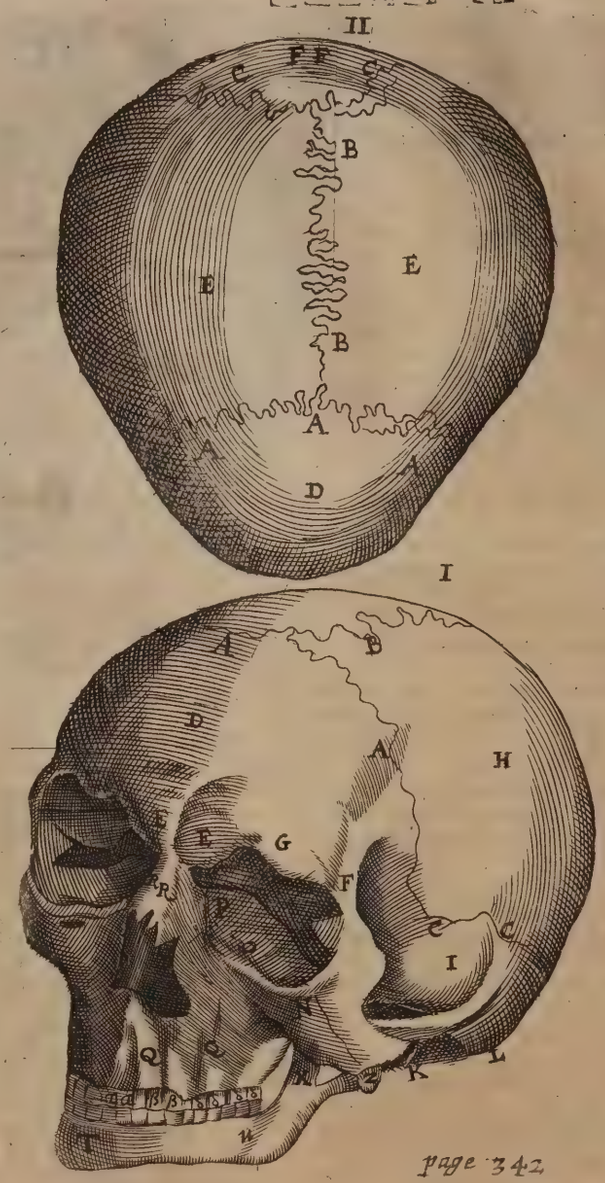

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FIG. II.

AAA. *The Coronal Suture.*
BB. *The Sagittal Suture.*
CC. *The Lambdoidea.*
D. *The Os frontis.*
EE. *The Bone, of the Sinciput, Bregma, or forepart of the Head.*
FF. *A portion of Os Occipitis or Hinder-head Bone.*

In Infants, that part which is at the Conjunction of the coronal and Sagittal Sutures is found Membranous, and ſoft, and among all the Bones of the Head, it laſt receives a boney hardneſs, then when the Child begins to ſpeak diſtinctly and intelligibly. while it remains Membranous and ſoft, it is not ſo thick as afterwards, but tranſparent. Hence in Children there is obſerved in that place a Gap or Chink, which ſome term *Fontanella* and *fons pulſatilis*; where alſo they are wont to make Iſſues in deſparate Catarrhs. I have once obſerved this part in a perſon grown up, to have been not yet boney, but membranous as in Children, viz. in a man of years of Age. *Bauhinus* in a Woman of twenty ſix years old, found it remaining ſtill open.

There are within ſuperficial *Cavities*, being the impreſſions of Veins, and without certain ſmall holes.

The *fourth Bone* of the *Occiput* which ſome call *Baſillare*, *Os proræ*, *Os memoriæ*, *Os pixidis*, the Greeks *inon*; doth conſtitute almoſt the whole hindermore and inner part of the Skul.

Which in grown perſons is commonly *but one*, ſeldom double or treble; in Children it conſiſts for the moſt part of four, ſeldom of five bones. Its

Its *Figure* is of a Sphærical triangle,

Its *Substance* is the thickest and most compact of all the rest (because there the noble Ventricle is seated, and there the Nerves arise as from a Fountain) especially at the Basis of the Skull, save at the sides of the great hole, where it is most thin (and therefore in this respect *Aristotle* did well say, that this was the thinnest Bone of all, which *Columbus* taxes) and therefore for safeties sake, there is in the middle thereof a long *Prominency*.

It hath *five holes*, one which is the greatest neer the first Vertebra, through which the *Medulla oblongata* passeth forth; the rest are lesser serving for the going out of Nerves and the entrance of Veins and Arteries.

It hath nine Cavities, seven within and two without.

It hath before two broad Processes at the Basis (in Children they are Epiphyses) covered with a Gristle, within more eminent, inserted into the Cavities of the first Vertebra, for the motion of the Head. There is another small Process behind, joyned to the first Vertebra.

In the Hinder-head of Dogs, there is another small *bone* between the Brain and the Brainlet, which is *triangular*: that it may as a Prop sustain their going with their heads downwards.

The triangular bone in Dogs.

The *fifth* and *sixt*, are the *Temple Bones*, by the Ears; some call them *Lapidosa*, *Petrosa*, *Saxea*, *Squamiformia Mendosa*, and others *Parietalia* and *Arcualia*.

Their *Shape* is uneven (but rather circular than three square) because of their manifold Substance, which is like Rocks and craggy Clifts; for which cause they are also called *Ossa petrosa* the rocky bones. But in their upper part they are attenuated, so as to be transparent, where they lie under the temporal Muscles, and are joyned to the bones of the Sinciput, like Scales,

They have six *holes* without, two within. the first external hole is large, *viz.* The Auditory passage; the rest are small, for Vessels to pass thorough.

They have two *Cavities*. The outer is covered with a Gristle,, and receives the lower Jaw-bone. The inner is longish, common to the *Os occipitis*.

The FIGURES Explained.

This TABLE demonstrates the inner structure of the Organ of Hearing, with the little Auditory Bones.

FIG. I.

AA. *Os temporis, the Temple Bone.*
bbb. The scalie Suture of the said Bone.
cc. The Os spongiosum, or Spungy-bone.
D. *The Cavity into which the Auditory Nerve is inserted.*
e. The boney Circle.
ff. The greater winding of the Cochlea.
ggg. Three boney half-circles, which form the Labyrinth.
h. The Malleus or Hammer in its situation.
i. The Anvil or Incus.
k. The Stapes or Stirrup.
l. The external Muscle of the Ear.
m. The internal Muscle of the Ear, of which see B. 3. chap. 9.

FIG. II.

aaa. The Labyrinth.
b. The Cochlea.
c. The oval hole where the Stapes is seated.
d. Fallopius his Aquæ-ductus.
e. The Fenestra Rotunda, round window.
ff. Little holes to let out Veins and Arteries.

FIG. III.

aa. The Cochlea dissected.
bb. An intermediate space or thing dividing the Cochlea into two wreaths.
c. A round hole, ending into the Cavity of Hearing, and the lower wreath of Cochlea.
ddd. The wreathings or Circumvolutions of the Labyrinth opened.
e. The Fenestra ovalis, or oval window.

FIG. IV.

a. The round Head of the Malleus or Hammer.
b. Its end whereby 'tis fastned to the Drum.
c. The smaller process of the Malleus, Mallet or Hammer.
d. The larger and more fine process thereof, first observed by Folius.
e. The Incus or Anvil, whose upper part hath a Cavity to receive the Head of the Hammer.
f. The longer process of the Anvil, to which the Stirrup is fastned.
h. The Stapes or Stirrup.
i. A fourth little bone fastned to the Stapes or Stirrup by a Ligament, first observed by Fr. Sylvius.

FIG. V.

Shews the boney Circle in Infants, to which the Membrane of the Drum is fastened.

TABLE III.

It

It hath a certain *Appendix*, ſharp, long and ſmall, and therefore called *Styloïdes*, *Belenoïnes*, *Graphioïdes*, *Plectrum*, &c. It is ſoon broke off, and therefore it is not in all Skuls, eſpecially ſuch as are dug out of the ground. In grown perſons 'tis bony, in Infants Griſtly. It is a little crooked, like a Cocks Spur.

It hath three *Proceſſes*.

1. Is *external* and obtuſe, thick, ſhort and cavernous, *id eſt*, having holes like a Spunge in it; it's cal'd from its ſhape *Squamoſitaris*, Dug like.

2. Is *External* alſo, and a portion of *Os jugale*.

For the *Os jugale* or *Lygomatis*, ſeated under the Eye, is not a peculiar bone, but is made up of the Proceſſes of two bones; the one is that newly mentioned, the other is that of the Jaw, joyned by an oblique Suture, making as it were a Bridg: whoſe *uſe* is to defend the Tendon of the temporal Muſcle, the Skul being otherwiſe but thin in that place.

3. Is *Internal* with a long protuberancy, wherein there is a threefold Cavity: the *Drum*, the *Labyrinth*, the *Cochlea*, alſo the bones which ſerve the Hearing. But if the outer paſſage before the Membrane of the Tympanum be reckoned, there wil be four Cavities of the Auditory paſſage. The Ancients makes mention but of one Cavern.

The Cavities in the Oſſa petroſa.

I. The firſt Cavity, which is the *Tympanum* or *Concha*, or as ſome call it *Pelvis*, and by *Ariſtotle* termed *Cochlea*, is ſituate preſently after the little Membrane of the Tympanum (about which goes a *boney circle*, eaſily ſeparable in Infants, in elderly perſons hardly) wherein is the Congenit or inbred Air, alſo four little bones, a Ligament and Muſcles, little Windows and a water-paſſage; and from this Cavity a Channel goes into the palate of the Mouth. It doth not tranſmit the Congenit Air, which Nature ſtudies to retain.

The *Feneſtræ* or Windows, are two little holes in this Cavity: the *one oval*, is in the middle of the Cavity, more towards the fore-part, and higher, upon which the Baſis of the Stapes or Stirrups reſts, and in a great meaſure ſhuts the ſame: in the hinder part, it opens it ſelf into the Cochlea with a large overture, and joyns it ſelf alſo to the *hinder hole* which is *lower* in mankind, leſſer and narrower: and this is divided into two channels, divided by a very thin bony Scale: with the one it goes, together with the oval window unto the Cochlea, with the other to the Labyrinth; and the hindermore channel is called *Aquæ-ductus*, alſo *Meatus cochlearis*, *Tortuoſus*, *Cæcus*, *Capreolaris*, by reaſon of the crooked winding paſſage, through which the greater part of the Auditory Nerve is carried with the Artery.

II. The ſecond being round and leſs than the former, is called *Labyrinthus* and *fodina* the Maze and Mettal-mine or Cole-mine, becauſe of its crooked manyfold turnings: behind the Feneſtra ovals, it joyns it ſelf to the following Cavity. From this, many waies run out. which they call *Semicirculos oſſeos excavatos*, hollowed boney Half-circles, or *funiculos* little Ropes, three for the moſt part, large at the beginning, and then by little and little growing narrower, cloathed with a little thin Membrane, that the ſounds may become more acute, and being by little and little broken may ſo aſcend unto the Brain. It hath four holes beſides the oval, and a fift which is terminated into the Cochlea.

III. The third is termed *Cochlea* becauſe of its wreathed turning, others call it *Cavitas cochleata*, *Buccinata*, *Antrum buccinoſum*, &c. for it hath three or four windings (thoſe who are thick of Hearing have only one or two) mutually receiving one another, and is cloathed with a very exceeding thin and moſt ſoft Membrane, and is adorned with infinite little Veins, which being twined about the wreathings of the Cochlea, doth by many branches creep into the ſecret turnings of the Labyrinth.

Chap. 7. *Of the Bones which ſerve the Senſe of Hearing.*

THere follow eight other Bones of the Head, which are leaſt of all, on each ſide four, being the Bones ſubſervient to the ſenſe of Hearing, called from their ſhapes, *Malleus* the Mallet or Hammer, *Incus* the Anvil, *Stapes* the Stirrup, and the *Orbicular* bone: all which were unknown to the Ancients. The two firſt were found out by *Jacobus Carpus*, who was afterwards followed by *Maſſa*, *Jacobus Sylvius*, and *Veſalius*: and he being admoniſhed by *Fallopius*, at laſt made mention of the third, whoſe firſt finder out was *Ingraſias*; although *Euſtachius* and *Columbus* do arrogate the Invention hereof unto themſelves.

The fourth Auditory Bone, was found out and ſhewed to me by *Franciſcus Sylvius*, being round and ſmall, and by *N. Fontanus* likened to the Scale of a Pike: annexed by a ſmall Ligament to the Stirrup ſide, where it is joyned to the Anvil; which you ſhall more eaſily find in the boyled Calves Heads, in which they are bigger than in the Heads of Men: howbeit in a Man it is viſible enough. *Pavius* found in the Head of an Ox a year old, one like this, of a ſeſamoidean ſhape.

They are ſituate in the firſt Cavity or Concha.

They have a *Subſtance* hard and denſe, hollow within, that they might be lighter, and might contain in them, Marrow for their nouriſhment, without any Perioſteum about them: alſo that they might make the Air drier, and carry it along, like thoſe Ropes which are faſtened to doors to make them open and ſhut again of themſelves. They are as perfect in new-born Children as in thoſe that are grown up; though not ſo hard, but more moiſt, for which cauſe Infants are dull of Hearing.

The *Connexion*. The Hammer by its proceſs ſticks faſt to the Membrane of the Drum, beyond the middle, like a tail turned back; the head whereof is articulated into the Cavity of of the Anvil, having a ſmall Proceſs, that the Tendon of the *Muſculus rotundus* may be applied thereto; it hath alſo a longer Proceſs, but ſmaller, firſt obſerved by *Cæcilius Folius*, to which another Muſcle is faſtened, which belongs to the external Ear. It reſts athwart upon the bony circle, with which perhaps it grows together in perſons that are of years, for commonly in Children it is only viſible, in others it is eaſily broken becauſe of its fineneſs, when the bones are taken out.

The *Anvil* reſembling a grinding Tooth, lies under the Hammer, having beneath two proceſſes; the one ſhorter reſting upon the *Os ſquamoſum*, the other longer, ſuſtaining the top of the Stirup or triangular bone, which reſts upon the Cochlea, till it is ſunk into the broad Baſis of the *Feneſtra ovalis*, or oval window, to which it is faſtned by a looſe Ligament, ſo that it may be lightly raiſed, but not moved upwards and downwards.

Theſe three little bones, are *joyned* with a very fine Ligament, which is ſtretched over the whole Membrane, as the ſtrings over the bottom of a Drum.

The *Uſe* of theſe little bones is not to make a ſound, but that the ſpecies of ſound being received, may paſs to the lower parts, and that there may be a paſſage for the excrements of the Ears. For the Stirrup ſhutting the oval or upper window, is moved by the Anvil (whereupon the window is opened, that the ſpecies or repreſentation of Sounds may paſs into the Nerve, and the Anvil being ſmitten by the Hammer, and the Hammer by the Membrane of the Drum, through the impulſe of the external Air (which the Hammer hinders from being driven too far forwards) which while it is in doing, the membrane of the Drum is droven inwards, and becomes bunching out, whereby the inbred Air is affected, which wandring through the Cochlea cauſes, that the branches of the Auditory

ditory Nerve, do receive the ſpecies of ſounds, brought in by the windows, and communicate the ſame to the Brain. And thus the Hammer is moved only inwards. But in the recourſe, it is moved outwards, with the Membrane of the Drum, by that very little Muſcle found out by *Caſſerius*.

Chap. VIII.
Of the Bones common to the Head and upper Jaw, viz. Os cuneiforme and Os ſpongioſum.

THe *Os Sphænoides* or *Cuneiforme*, or Wedg-faſhion'd Bone, ſo called becauſe as they ſay, it hath the ſhape of a Wedg; was by the Ancients called *Polumorphos* or many-form'd, by reaſon of ſundry proceſſes within and without whereby it is made rugged and uneven: others call it *Os Paxillare, Os Colatorij, Os Palati, &c.*

'Tis *ſeated* in the middle of the Baſis of the Head, and is placed under the Brain as a foundation, ſo that it touches well-neer all the Bones of the Head and upper Jaw.

It is *one Bone* in grown perſons: but it is at firſt made of four which are afterwards united.

The *Proceſſes* are ſundry.

Outwardly there are two remarkable ones, at the ſides of the palate, cal'd *Pterigoeides, aliformes*, Wing-faſhion'd, becauſe they reſemble the wings of Batts or Flittermice, and are furniſhed with a longiſh Cavity.

Inwardly there are four little ones, on each ſide two, having the ſhape of a Turkiſh Saddle. and therefore this proceſs is termed *Sella Sphænoidis*, the ſaddle of *Os Sphænoïdes*; in which proceſs being ſquare and broad, there is a Cavity to hold the *Glandula pituitaria*.

At the Saddle, there is a *Cave* full of little holes, that the inbreathed Air, may be elaborated to make Spirits; and that flegmatick excrements, may diſtill through the funnel, out of the Ventricles of the Brain.

It hath ſundry *holes* for the paſſage of the Veſſels this way and that.

Os SPONGOIDES, *ſpongioſum* or *Spongiforme*, the ſpunge-like bone, being ſeated in the middle baſis of the Fore-head, and filling the Cavity of the Noſtrils, is alſo called *ethmoëides, Cribriforme* or *Cribroſum*, the Seive-faſhion'd bone: becauſe

Its inner ſide, where it joyns to the Head, is pierced through with many holes like a Sieve, winding and turning, but not ſtreight; and this part properly is, and ought to be called *Cribroſa*, Sieve-faſhion'd.

It *hath* in its middle a *ſharp Proceſs*, reſembling a *Cocks comb*, by which as a Partition this bone is divided into two parts: And to this upper proceſs *another* is oppoſed below, diſtinguiſhing the Noſtrils, where the outer part of this bone is, which is contained in the Cavity of the Noſtrils without the Skul, being light and ſpungie, and therefore there properly ſo called.

It hath alſo another part thin, ſolid and ſmooth, where it is joyned to the ſocket of the Eye, a ſmall portion whereof it conſtitutes, but it is not a part of the upper Jaw-bone, as *Veſalius* would have it.

The *Uſe of the ſpongie part* is, to alter the Air drawn in with Smels.

The chief *Uſe* of the *Sieve-faſhion'd* part is,

1. To admit the Air for Animal ſpirits.

2. That the Species of odours may with the Air be carried to the mammillary proceſſes, the Organs of ſmelling, which end into theſe holes. And therefore in the Diſeaſe *Coryza*, this bone being obſtructed, the ſmelling is loſt.

A ſecondary uſe, is the purging of the Brain. for flegm is not only voided by the *Glandula pituitaria* into the Palate, but it drops down alſo into the *Os cribroſum* and the Noſtrils, if the upper Ventricles of the Brain ſo called, do abound with too much Flegm. Howbeit, this Flux is preternatural.

Chap. IX. *Of the Bones of the Jaw in General.*

THe *Jaw-Bones* are the foundations of the whole Face, the *upper* above the mouth the *lower* beneath.

For the upper, which *Celſus* calls *Mala*, is the boney part of the Face, comprehending the lower and lateral parts of the Eye-ſocket, the Noſtrils, the Cheeks, the Palate, and the whole row of the upper Teeth.

And this Jaw-bone in Mankind, is ſhorter and rounder than in Brutes, for Beauties ſake, alſo it is immoveable as it is in Beaſts, ſaving the Parrot, the Phænicopterus, and the Crocodile as wel that which lives in the water, as the Land-Crocodile; yet do they not move the upper Jaw only, but their whole Head withall being ſtraitly faſten'd thereto, as Vipers do, and the like is to be ſaid of the Parrot.

But the *lower* Jaw-bone in Mankind and other Creatures, is only movable, ſave in the Crocodile, which hath it ſo united to the Bones of the Temples, that it can no waies be ſtirred; but the Parrot moves both.

The *Connexion* is without motion in the upper Jaw, by a Suture or Harmonie whereby it is joyned with many bones of its own, of which it is compoſed, and other bones placed round about; in the *lower* by way of *Synchondroſis*, which is in the middle of the Chin. But in grown perſons, the Griſtle is ſo turned into a Bone, that the lower Jaw ſeems to be one only bone, whereas before it conſiſted of two.

In the Brim or Circuit of each Jaw-bone, which place *Galen* calls *Phatnian*, we meet with Cavities, wherein the Teeth are faſten'd, which *Galen* terms *Bothria*, the Latines *Alveolos, Loculos, Foſſulas, Præſepiola, Mortariola*.

Theſe *holes* according to the nature of the teeth in them, are ſomtimes ſingle, otherwhiles threfold: ſomtimes they are obliterated and ſhut up, the Teeth being fallen or pluckt out. Somtimes they breed anew, by freſh Teeth breaking out. In old Age, frequently theſe holes are obliterated, the Teeth being loſt, and the Gums become ſharper and harder, ſo that old folks chew their meat with them inſtead of Teeth.

Chap. X. *Of the Bones proper to the upper Jaw.*

THe *Bones proper to the upper Jaw*, are *eleven* on each ſide five, and one without a fellow.

The *firſt* being in a manner triangular, doth make up the lower part of the ſocket of the Eye, the leſſer Eye-corner, and part of the *Os jugale* and of the Cheek-bone.

The *ſecond* makes the greater Eye-corner where there is an hole which paſſes into the Noſtrils, by which a Caruncle is placed.

Here thoſe Impoſthumes are made which they call *Ægilopas*, which if they be unskilfully or negligently handled, they pierce to the Bone, and cauſe the *Fiſtula Lachrymalis*.

This is a little Bone, and the leaſt among the upper Jaw-bones, Thin, Tranſparent, Looſly, Adhereing, ſo that it is eaſily broken and loſt: and therefore 'tis ſeldom found in Skuls dug out of the Earth.

The *third* is a very great one, by which are conſtituted the large region of the Palate, and the great lower ſocket

containing the Teeth. It hath large Cavities (and holes through which veſſels paſs) on both ſides remarkable, both for to make it lighter, and that it might contain Marrow to nouriſh the Bones and the upper Teeth. Others ſay to help to frame the Voyce. In Children they are not hollowed til after ſome years, and they are then cover'd with a very thin Membrane.

The *fourth* with its companion, doth conſtitute the upper and more eminent boney part of the Noſe.

It is thin, hard, ſolid and quadrangular.

And theſe two external bones of the Noſe are divided with a *Suture*. Within they are rough, that the Griſtles of the Noſe, may be the better faſtened.

There is another inner bone (which is the third of the Noſe) cleaving to the proceſs of the *Os ſpongioſum*, which is called *Septum narium* becauſe it diſtinguiſhes the Noſtrils.

The *fift* is ſeated at the end of the Palate, where the holes of the Noſtrils go into the Throat or Fauces. ☞ They

TABLE IV.

The FIGURES Explained.

This TABLE preſents the lower part of the Skul, to be ſeen within and without.

FIG. I.

AAAA. *The two Boards of the Skull with the marrowy ſubſtance between them.*

B. *The Cavity in the Forehead bone, ending into the wideneſs of the Noſtrils.*

cc. *The Os Cribroſum or Sieve-like bone full of little holes.*

D. *Its acute proceſs reſembling a Cocks combe.*

EE. *The two inmore and foremore proceſſes of the Os Sphænoides or Cuneiforme.*

FF. *The two inner and hindermore proceſſes of the ſaid Bone.*

GG. *The holes of the ſaid bone for the optick Nerves to paſs out.*

H. *The Cavity cut in the middle of the Saddle, wherein the Glandulæ pituitaria is contained.*

I. *Another cavity whereon the conjunction of the optick Nerves doth reſt.*

KK. LL. MM. } *Shew the holes of the Os cuneiforme, for the paſſage of the veſſels,*

NN. *The Proceſſus petroſus of the Temples-bone.*

oo. *An hole in the ſaid proceſs, for the Audisory Nerve to paſs through.*

pp. *An Additament or Appendix of the Os Occipitis.*

Q. *The greateſt hole of the Os occipitis through which the ſpinal marrow paſſes.*

RR. *The Cavities of the Os occipitis within the Skull, in which the Cerebellum or Brainles reſts.*

FIG. II.

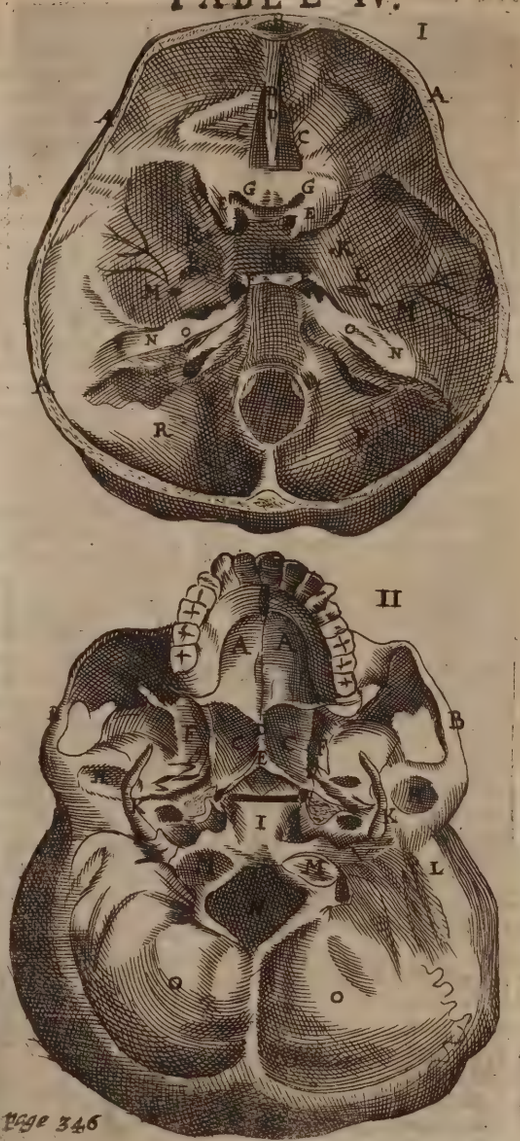
AA. *The fift bone of the upper Jaw, diſtinguiſhed by a Suture.*

BB. *The Os jugale.*

CC. *Holes opening into the wideneſs of the Noſtrils.*

D. *The partition of the Noſtril.*

E. *The eleventh bone of the upper Jaw, which Columbus calls Aratrum.*



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FF. *The external proceſſes of Os cuneiforme, like Bats wings.*

gg. *The Cavity of theſe Proceſſes.*

HH. *The Cavity of the Temple-bone, receiving the Head of the lower Jawbone.*

I. *An Additament or Appendix to the Os occipitis.*

KK. *The proceſſes of the Temple-bones, call'd Styloides proceſſus.*

LL. *The mammillary proceſſes.*

MM. *Two Heads or proceſſes at the Baſis of Os Occipitis, whereby it is articulated into the firſt Vertebra.*

N. *The greateſt hole of the ſaid Bone.*

OO. *The two ſides of Os Occipitis, furniſhed with divers protuberancies.*

are distinguished one from another by the middle Suture of the Palate, and make the hinder part of the Cavity of the Palate and Nostrils, they are thin, solid and broad.

To these ten *Columbus* ads the *eleventh*, like a Plough, the inmost and middlemost above the Palate, shutting the lower part of the Nostrils, like a partition wall.

Chap. XI.
Of the lower Jaw-bone.

THe *lower Jaw-bone* in grown persons, consists of one Bone only, in Children till seven year old of two, which are joyned together by way of *Sunchondrosis*.

Its *Figure* is that of the Greek letter υ or like a Bow.

Its *Substance* is exceeding hard and strong, that it may hold out in biting and chewing; within hollow, where Marrow is contained to nourish it and the teeth.

It hath two *Holes* on each side, which go quite through the Jaw-bone like a Pipe, so that a bristle put in at one hole will come out of the other.

The one is more *inward*, hindermore and greater, receiving in a part of those Nerves which we reckon to be the fift pare, to the Roots of the teeth, with a little Vein and Artery.

The other is more *outward*, less round, by which a Branch of the foresaid Nerve received in, is sent out to the lower Lip.

It hath sundry *Aspcrities* and *Cavities* for the Risings and Insertions of Muscles.

Also on each side two *Processes* called *Horns*, carried upwards.

One goes out forwards broad and thin, whose point or sharp end is called *Corone*, into which the Tendon of the Temporal Muscle is implanted. And therefore *Hippocrates* counts the Luxation of the lower Jaw-bone deadly.

The *other* hindermore, is carried backwards; representing a little bunch and is called *condulodes*, having a little Head coverd with a gristly crust, under which there is a longish Neck.

By this Process the Articulation is made with the Temple bones, where yet another Gristle is placed, between the Cavity and the gristly head, to facilitate the motion. Also a common membranous *Ligament* doth cover this Articulation.

Chap. XII.
Of the Teeth in General.

THe Teeth are called DENTES as if you would say *Edentes*, Eaters, and by the Greeks *odóntes* as it were *edôuntes* Eaters; and they are Bones properly so called, hard and solid, smooth and white, like other Bones.

How the Teeth do differ from other Bones.

They have some things peculiar which other bones have not, which nevertheless doth not exclude them from the number of Bones.

1. They are harder than other Bones, that they may bite and chew hard things; and they are little less harder than Stones, nor can they easily be burnt in the Fire, and whereas in the *Sarcophagus* or Flesh-eating Stone, the whole body is consumed in forty daies, the Teeth remain unimpaired. and therefore *Tertullian* writes that in them is the Seed of our future Resurrection.

2. The Teeth are naked without any Periosteum, least they should pain us when we chew.

3. Yet they have a Sense, but more of the first than of the second Qualities, and especially rather of what is cold than what is hot contrary to the Nature of flesh, according to *Hippocrates*. and hence they are so apt to be set on edg.

Which part of the Tooth feels.

But the whole Tooth doth not feel of it self, but the inner, softer and more marrowy part; which is covered over with an hard external part, which is not pained, neither by Fire, nor Iron, as in a Sword under the most hard rind of the Steel, an Irony marrow less hard lies within, and the Skin through the sensless Skarf-skin doth feel, so the inner part of the Tooth feels through the outmost, into which inner part being hollow, little soft Nerves enter and little cloathing Membranes. Hereupon a certain Nun at *Padua* causing a very long Tooth shee had above all the rest to be cut off to avoid the Deformity thereof, shee presently fell down into a Convulsion and Epileptick fit. Now in the part of her Tooth which was cut off, there appeared the tokens of a Nerve.

4. Hence, they receive Nerves into their Cavity which other bones do not.

5. They grow longer than any other of the Bones, almost all a mans life, because they are dayly worn, by biting and grinding; as

Gutta cavat lapidem non vi sed sæpe cadendo.
The hardest Stone a dropping House-Eve hollows,
Cause drop upon drop, drop after drop still follows,
But not by force.

And look how much they wear away, so much are they still augmented. which hence appears; in that if any Tooth fall out and grow not again, the opposite Tooth grows so much the longer, as the empty space of the former Tooth comes to.

Fallopius considering the præmises, and how new Teeth are thought to breed, he collects that the formative faculty remains alive in the Teeth to extream old age.

Helmont counts the matter of the Bone not to be meerly boney, but as it were of a middle nature betwixt Bone and Stone; because the Teeth turn to Stone whatever kind of food sticks long to them, be it Bread, Flesh, Herbs, Fish, Apples, Beans, or Pease, &c. But there is no petrification or turning to Stone, unless the things eaten be of a tartareous Nature, but only a drying, the moisture being consumed by the Spittle; nor are the Teeth made bigger by that addition, which somtimes is scraped off, somtimes turne to clammy filth.

The Teeth are bred in the Womb.

The Teeth *are bred* in the *Womb*, after the Generation of the Jaw-bones, twelve in each Jaw, or a few more, as I shall speak hereafter touching their number, four Cutters, two Dog-teeth, six Grinders: which lie somwhat imperfect and concealed within the Jaws (for it is rare for an Infant to be born toothed) least the child as it sucks should hurt the Nipple. And therefore in an Abortion, or a young Infant, small teeth may be pulled out.

They break out of the Gums sooner in Brutes (though *Varro* be otherwise minded as touching Horses) because they are sooner capable of solid meat; in mankind at the seventh month or later, after the Child is a year old: and the upper sooner than the lower, yet in some the lowest first, and among the rest,

The *fore-teeth in the first place*, because

1. They are most sharp.
2. They are less then the rest.
3. Because the Jaw-bone is there thinnest.
4. Because there is most need of them both to speak with and to cut and bite the meat.

Why Children are sick of Teeth-breeding.

And at that time when the Teeth of Infants shoot forth, *Hippocrates* tels us that Feavers, Convulsions, Fluxes of the Belly arise, especially when the Dog-teeeth come forth: because when the Teeth make their way through the Gums, they torment more than pricks in the Flesh.

These Teeth have a *Substance* boney, hard, and hollow where they break out, but in their hinder part they have a soft substance, covered with a thin and transparent Membrane.

And

Why and when young ones looſe their Teeth.

And about the ſeventh and fourteenth yeer, *other Teeth are wont to break out* (the former falling away) in both the Jaws ten, four Cutters, two Dog-teeth, and four Grinders. And the former fall out in the fourth, fift, and ſixt year. becauſe the holes grow wider, and therefore the Teeth being at that time ſoft, do grow looſe and fall out. *Nicephorus* in his Interpretation of Dreams ſaies, that for a man to dream he looſes a Tooth another comes in the Rome, betokens gain and unexpected Joy. If their Teeth do not ſhed, the latter Teeth come out at new holes, the upper commonly on the outſide, the lower on the inſide, as there were new ranks of Teeth. More frequently they ſpring out on the ſides and augment the number.

Whether new Teeth are bred out of the womb?

But theſe Teeth are not bred anew without the Womb: for then likewiſe Membranes, Nerves, Veſſels and Ligaments might be bred anew: but the ſeeds of them lie within the Jaws. For *Euſtachius* and *Riolanus* have obſerved ſome ſmaller Teeth at the back of the reſt which fall out, a very thin partition being removed which is found between the two ſorts of Teeth. But a rare caſe it is for Teeth to breed again, after many years and in old age. As *Thuanus* relates of a man that was an hundred yeer old: in our *Fionia* a man of an hundred and forty years of age, had new Teeth. *Helmont* ſaw an old Man and Woman of ſixty three yeers of age, whoſe Teeth grew again with ſuch pains as Children have when breed they teeth, which was no token of their long living, for both of them died that yeer. Sir *Francis Bacon* hath the like Example touching an old Man.

But now let us ſpeak of the Teeth in grown perſons.

The Teeth are *ſeated* in the Compaſs of the two Jaw-bones, in Mankind, ſhut up within his mouth; in a Boar they ſtick out, as alſo in the Whale-fiſh cal'd *Narhual* in our *Greenland*; which ſends out an exceeding long wreathed Tooth, out of the left ſide of his upper Jaw, which is commonly taken for the Unicorns horn, and is yet of great value among Noble Men and Princes.

In *Magnitude* they come ſhort of the Teeth of other Animals, becauſe of the ſmallneſs of Mans mouth. And in Mankind ſome have greater, others leſs.

They vary in *Figure*. In Man they are of a threefold figure: Cutters, Dog-teeth, and Grinders, as ſhall be ſaid in the following Chapter; ſave that *Fontanus* obſerved in a certain Man, that they were all Grinders which he had. In Creatures that *chew the Cud* they are double; Cutters and Grinders. In Fiſhes they are in a manner all perfectly ſharp, excepting one kind of Whale, which the *Iſlanders* call Springwall, whoſe teeth are blunt, but broad.

The *Surface* is ſmooth and even.

The *Colour* white, and ſhining, unleſs negligence, Age, or ſickneſs hinder.

The *Number* is not the ſame in all Men, for to let paſs rarities, viz. that ſome men are born with one continued tooth in their upper Jaw-bone (which they relate of *Pyrrhus*, and a certain Groenlander brought hither in the Kings Ships) alſo of a double and tripple row of teeth, ſuch as I have ſeen in ſome Fiſhes, and ſuch as *Lewis the thirteenth* King of *France* had, and which *Solinus* writes of *Mantichora*, and is known of the *Lamia*, which hath five ranks, ſtrangely ordered, and among them exceeding ſharp teeth, reſembling the ſtones called *Gloſſopetræ*, and therefore *Columna* took the teeth of a Lamian turned to ſtone, to be the *Gloſſopetræ* or precious Stones of *Malta* ſo called, of which I have ſpoke elſwhere. In a Sea-wolf, I have obſerved a double rank, the former of ſharp teeth, the inner of grinders, cloſe joyned together, which poſſeſs the lower part of the Palate. A man hath ordinarily but one rank in each Jaw-bone, and *twenty eight* in all, ſomtimes *thirty*, in the upper Jaw ſixteen, in the lower fourteen; but for the moſt part *thirty two*, ſixteen in each Jaw.

But this number is ſeldom changed, ſave in the grinders, which ſomtimes are on each ſide five, ſomtimes four; otherwhiles five above, four beneath, or five on the right, and four on the left ſide, or contrarily.

Many teeth argue long life.

A great number of teeth argues length of life, few teeth a ſhort life, according to *Galen* and *Hippocrates*. And rightly. For the rarity and fewneſs of teeth is bad as a *Sign* and a Cauſe: for it argues want of matter, and the weakneſs of the formative faculty. As a *Cauſe*: becauſe few teeth cannot well prepare the meat, and ſo the firſt digeſtion is hurt, and conſequently the ſecond. But we muſt underſtand that this prediction holds for the moſt part, but not alwaies, as *Scaliger* well diſputes againſt *Cardan* in his 271. Exercitation. For *Auguſtus* who lived ſeventy ſix years, is ſaid to have had thin, few, and ſcalie teeth; and ſo likewiſe *Foreſtus* who lived above eighty years.

Their *Connexion* is by way of *Gomphoſis*, for they ſeem to be fixed in their holes as nails in a poſt. Alſo they are tied by ſtrong *Bands* unto their neſts, which bands ſtick to their roots; and then the Gums compaſs them, of which before.

The *outer Subſtance* is more ſolid and hard, not feeling; the *inner* is a little more ſoft, endued with ſenſe, by reaſon of the neighborhood of a Nerve and Membrane, and hath in it a Cavity, larger in Children then Elder perſons, and compaſſed about till they be ſeven years old, with a *thin Scale* like the Combs of Bees, and full of ſnotty matter; in grown perſons the humor being dried up, it is diminiſhed.

The Diſeaſes and Pains of the Teeth, how cauſed?

This Cavity is cloathed with a *little Membrane* of exquiſite Senſe, which if it imbibes ſome Humor flowing from the Brain, extream Tooth-ach follows. In this begin Eroſions, Putrefactions, and moſt painful Rottenneſs; and herein ſomtimes grow the ſmalleſt ſort of worms, which exceedingly torment men.

Veſſels are carried to this Cavity, by the holes of the Roots of the Teeth.

As *Veins* to carry back the blood after nutrition and continual augmentation. Which are not ſeen ſo apparently in Mankind (as neither the Veins of the *adnata tunica* of the Eyes) but they are manifeſtly ſeen in Oxen, and are gathered from the ſprinkling of blood in the Cavity.

Little Arteries to afford Natural Heat and Blood for Nutrition and Alteration. And therefore upon an Inflamation, a pulſative pain of the teeth is ſomtimes cauſed, which *Galen* experimented in himſelf. Hence much lightful, ſhineing blood, comes ſomtimes from a tooth that has an hole made in it, and ſomtimes ſo as to cauſe death.

Little Nerves tender and fine, are carried to them from the firſt pare, according as we reckon, which go through the Roots into the Cavity, where they are ſpred abroad within, and by ſmall twigs mingled with a certain mucilaginous Subſtance found in the middle of the teeth.

The *Uſe* of the Teeth

In the *firſt* and chiefeſt place, is to chew and grinde the meat. And therefore ſuch as have loſt their teeth are fain to content themſelves with ſuppings; and therefore *Nicephorus* reckons that it is bad to dream of a mans teeth falling out, and ſaies it ſignifies the loſs of a Friend.

2. They ſerve to form the voice (and therefore Children do not ſpeak, till their mouths are full of teeth) eſpecially the fore teeth which help the framing of ſome certain Letters. Hence thoſe that have loſt their teeth, cannot pronounce ſome Letters, as for Example T. and R. in the ſpeaking whereof, the tongue being widened, ought to reſt upon the fore-teeth. Alſo the loſs of the grinders hurts the Explication or plain Expreſſion of the Words, according to *Galen*,

Speech hurt.

so that the Speech becomes slower, and less clear and easie. Let therefore such as have lost their teeth, procure artificial ones to be set in, and with a golden wire to be firmly fastned.

3. For *Ornament*. For such as want their teeth are thereby deformed.

4. *Homer* conceives the teeth are an edg to the tongue and Speech, to keep in a mans words, and prevent prating.

5. In Brutes they serve to *fight* withal, in which case a man uses his hands.

6. In the said Brutes, also to shew their Age. For the Age of an Horse is known, by looking into his Mouth, where before he is four years old that tooth to be seen which they term *Gnomon*, when he is four year old, there is another tooth seen with an hole in it that will hold a Pease, which every year grows less and less, till at eight years the tooth is filled up, becomes smooth, and no hole to be seen therein.

Chap. XIII.
Of the Teeth in Particular.

IN respect of their threefold Shape, their Situation, and Office, there are in Mankind *three sort* of *Teeth*: The *Fore-teeth*, the *Dog-teeth*, and the *Grinders*.

The *Fore-teeth*, from their Office which is to cut the meat, are termed *Ineisores* and *Incisorij Cutters*, also *Gelásinoi* the laughing teeth, because in laughing they are first discovered.

They are placed before, in the middle of the rest, in each Jaw four (some have only two in a Jaw, as large as four) broad and sharp like Swords, shorter then the Dog-teeth, and fixed in their Sockets with single Roots; and therefore they fall the sooner out, especially the upper-more. After these follow on either side

The *Dog-teeth*, so called, because of their sharpness, hardness, and use; for what the former cannot cut these do bruise and grind. They are commonly termed the Eye-teeth, not as some think, because they do almost touch the circumference of the Eye, seeing they hardly reach the lower part of the Laps of the Nostrils, but because a portion of that Nerve which moves the Eye, is carried unto them, and they are deeply rooted, and therefore it is counted dangerous to draw them, also when they are pained, the Eye-lids do pant a little.

Why Men have few dog teeth.

These teeth are two in each Jaw, on each side one, broad and thick in their basis, and sharp above. For a Man did not need many of these kind of teeth, seeing he is a gentle Creature, and hath hands to defend and offend.

They are fastned with simple Roots as the Fore-teeth are, but they are more deeply and firmly rooted: for their Roots exceed all the other teeth in depth, and they are longer then the upper teeth.

The remaining hindermore teeth are called *Molares*, both from their shape resembling Mill-stones and their use, because they grind the meat after it is cut, they are rough and great, hard and broad. The Germans call them the Cheek-teeth.

In men they are *more in number* then the Cutters; but the contrary holds in fierce Beasts, which use their sharp also to fight with.

They are commonly *twenty*, on each hand in both the Jaws five, although the number varies, as was said before.

The two last of these are termed *Dentes Sapientiæ*, the Teeth of Wisedom, also the teeth of Sense and Understanding, because they do then first break out (somtimes with very great pains, and otherwhiles without any pain) when men begin to be wise, about the twenty eighth or thirtieth year of their Age, and somtimes when they are very old; *Aristotle* saw them break out in some when they were fourscore, and *Walæus* at the Age of eighty three years. Somtimes they hardly appear, and otherwhiles they are scarce created; the Latins call them *Genuinos*.

Why the upper Grinders have more roots then the lower?

These Teeth are fastned by divers roots, either two and three, as the lower Jaw-teeth, or with three and four, as the upper Jaw-teeth, which have more roots then the other: Because,

1. They hang of themselves, otherwise then the lower teeth which are fastned partly by their own heavines.

2. Because the Substance of the upper Jaw is more rare and soft.

A Transition.

And so much for the first part of the Skeleton, viz. the Head: Now follows the second Part, or *Trunk*.

Chap. 14. *Of the Back-bone and its Vertebra's in General.*

IN the Trunk or other Part of the Skeleton, all the *Vertebræ* of the *Back-bone* are to be examined, also the *Ossa Ischij*, the *Ribs*, the *Breast-bone*, the *Channel-bones*, and the *Shoulder-blades*.

What the Spina is?

All that is termed the *Spina* or Back-bone, which reaches from the first Vertebra of the Neck to the *Os coccygis*, or Crupper-bone. It is called *Spina* the *Thorn*, because the hinder part therof is all along sharp-pointed like a thorn branch.

The Parts of the Spine or Back-bone are termed *Sponduloi* in Greek, in Latin *Vertebræ Whirl-bones*, or *Turning-bones*, because by means of them the Body is turned several waies.

And these Bones of the *Spina* are divided into seven Vertebræ of the *Neck*; twelve of the *Back*; five of the *Loins*, and five or six of the *Os sacrum*; to which is added the *Crupper-bone*.

All the Vertebræ are hollowed, to contain the Spinal Marrow, they were to be *many*, not one, both for Motion which ought to be made forward and backward; also that the hurting of one might not draw the whole Spine into consent. The Father of *Nic. Fontanus* saw five Vertebræ or Whirle-bones of the Spina in a cluster like a round ball, in the Body of a Porter that carried burthens. And *Pavius* hath observed that in decrepit old people these Vertebræ grow together into one, the moisture being dried up, and the intermediate Ligaments hardned, which he represents by a Picture. *Tulpius* saw the Back-bone in a Boy divided into two parts, and *Salmuth* hath seen it broke asunder in persons that were hanged.

The *Figure* of the whole Back is, that *somtimes* it inclines *inwards*, as the Vertebræ of the Neck, to sustain the Gullet and aspera Arteria; and those of the Loins, for the Trunk of the Aorta and the Cava descending. *Somtimes outwards*, as of the Back, and a little of the Os sacrum; that there may be a larger space for the Heart, Lungs, Bladder, Fundament and Womb.

And these Parts do bend more outwards in Women, for the sake of the Child in the Womb.

The Figure of each Vertebra above and beneath, is plane and broad, that luxation may not easily be caused, round within, convex and bunching out; but in the neck broader and more even, by reason of the Wezand and Gullet resting thereupon. On the outer or Back-point, the Vertebræ are furnished with many prominencies.

For there are three kind of *Processes* in every Vertebra.

I. *Four oblique ones,* two on the upper part aſcending, two in the neither part deſcending.

II. *Two tranſverſe,* for the Original and Inſertion of the Muſcles. And they are in the Vertebræ of the Neck broad and bored through; in the Back thick, ſolid and round, excepting the eleventh and twelfth.

III. *One ſharp one,* in the hinder part, which is properly called the Spine or Thorn, and is wanting in the firſt Vertebra.

They have five Appendixes. Two above and beneath at their Body; as many at their tranſverſe Proceſſes, and one at the extremity of the *Spine.*

There is a moſt wide hole in the middeſt of each Vertebra for to keep the Spinal Marrow in. Alſo there are other holes in the ſides, which are leſſer, to let the nerves out, which *John Leonicenus* affirm to go out only at the joyntings of the Vertebræ.

The Subſtance of each Vertebra, is thicker and more ſpungie in the inſide: to which grow the *Epiphyſes* and *Griſtles.* For the extream Parts of the Vertebræ, excepting the firſt of the Neck, are furniſhed with Appendixes, between which there come thick and ſoft *Griſtles,* that they may be more eaſily moved; ſo that above and beneath, they have Griſtles, which in the Os ſacrum are harder and drier, becauſe this Bone is immoveable.

The Vertebræ are *knit together* by Articulation in the hinder part, viz. by the way of *Ginglumos,* but in the fore part by way of *Symphyſis,* and that by very ſtrong Ligaments or Bands.

Now the *Ligaments* of the Vertebræ are twofold.

Some do knit the Vertebræ above and beneath, and are ſhaped like the half Moon, thick, ſtrong, fibrous, and ſnottie.

Others ariſe from the Epiphyſes, as well the tranſverſe as the ſharp ones, which are membranous, by which the Proceſſes are more ſtrongly tied.

Chap. XV.

Of the Vertebræ or Whirl-bones of the Back in Particular.

THe Vertebræ of the *Neck* are commonly ſeven. In Brutes for the moſt part ſix only, and *Busbequius* relates that the *Hyena* hath none, who is confuted by the Skeleton of that Beaſt in the cuſtody of *P. Caſtellus.* Theſe Vertebræ of the Neck, have ſome Peculiarities, whereby they differ from the reſt.

I. Some of them have their tranſverſe Proceſſes cleft in two.

II. Alſo they have them bored, for the cervical Veins and Arteries, aſcending into the Brain.

III. They have a cloven Spine or thorny Point.

The *two firſt* are joyned by Ligaments to the hinder-part of the Head, that they may ſtick moſt cloſe to the Head, and have ſomwhat peculiar to themſelves, which the other five have not.

Why the firſt Vertebra has no Spine?

I. Is termed *Atlas,* becauſe it ſeems to bear the Head up, which reſts upon the two hollows thereof. Some call it *Epiſtrophens,* though more give that Name to the ſecond. It *hath no Spine* or *ſharp Point,* leaſt the two ſmall Muſcles of the Head which ariſe from the ſecond Vertebra, ſhould be hurt when the Head is ſtretched out.

It hath a thinner, but more compact *Subſtance.* It receives, and is not received: and therefore it hath its Cavity covered with a Cartilage, to receive the tooth of the following Vertebra.

II. Is called *Epiſtropheus* from turning: for out of the middle of its Body, there riſes an Appendix (others call it a Proceſs) round and oblong, like a Dogs tooth, about which the Head with the firſt Vertebra is turned.

An incurable Squinzie by Luxation of the Tooth.

Hence that Appendix is called a tooth; yea and the whole Vertebra is by *Hippocrates* ſo called, by the Luxation whereof, he conceives an incurable Squinzie, is often cauſed.

The Suface of the Tooth is in ſome ſort rough, becauſe thence proceeds the Ligament, whereby it is bonnd to the *Occiput* or hind-part of the Head, about which alſo is wound a ſolid and round Ligament, like a Nerve in ſhape, wonderous artificially twiſted, that the Marrow may not be compreſſed and hurt.

Now this ſecond Vertebra is joyned with the firſt, by a broad *Ligament,* turned round.

The laſt does more agree with the Vertebra's of the Cheſt, and hath its laſt Proceſs not alwaies cloven.

The *Vertebræ of the Back* are commonly *twelve* in number; to which ſo many Ribs on each ſide are articulated: ſeldom one is wanting; and there is ſeldomer one more.

They are thicker then thoſe of the Neck; leſs ſolid, and full of little holes, for the paſſage of the nouriſhing Veſſels.

I. Is by the Ancients called *Liphiá,* becauſe it is higher, and ſticks out more then the reſt.

II. Is termed *Maſchaliſter* Axillaris the Arm-pit Vertebra.

The reſt are called *Coſtales* the Rib-vertebræ.

The eleventh is termed *Arrhepès,* becauſe the Spine or ſharp point thereof is ſtraight.

The twelfth is called *Diazoſter* the Girder.

The five of the *Loins* are the thickeſt and greateſt, being full of little holes, whoſe motion is looſer then that of the Back, that we may more eaſily ſtoop to the ground.

The tranſverſe Proceſſes are longer, but thinner, excepting the firſt and fift; but the Spines are thicker and broader, to which the Muſcles and Ligaments of the Back are faſtned.

1. Is termed *Nephrites,* from the Kidneys which reſt thereupon.

The *laſt,* is by ſome called *Aſphalites,* the ſtabliſher or underpropper.

The reſt agree with the others aforeſaid.

The Os ſacrum why ſo called.

The *Os ſacrum* or *holy Bone* follows, ſo called, becauſe it is the biggeſt of the Spine or Back-bone, for the Ancients termed that which was great, Sacred. Or becauſe it lieth under the obſcæne or privy Parts, which Nature her ſelf covers and hides: For *Sacrum* did alſo ſignifie *execrable,* as *Servius* ſhews from *Petronius,* commenting upon that Expreſſion of *Virgil*; *Auri ſacra fames*: the curſed thirſt of Gold.

It is broad and immoveable, being the Baſis or Foundation of the Back.

Its *Figure* is commonly triangular. It is in its fore-part hollow, ſmooth and even; behind it is bunching and rough.

Os ſacrum properly hath no Vertebræ.

Its Vertebræ ſo called, not in regard of uſe but ſimilitude, are *five,* ſomtimes *ſix,* in young Children eaſily ſeparable, in grown perſons ſo glewed together, that they ſeem to be but one Bone. *Solomon Albernus* and *Pavius* have ſomtimes obſerved them to be ſeven in Number.

Galen makes the Os ſacrum to conſiſt of three Bones; becauſe he comprehends the other Bones of Os ſacrum under the Crupper-bone, and calls that an Epiphyſis, which others call *Os Coccygis.*

The Holes are not in its ſides, as thoſe of the former, but in the fore-part (which are greater, becauſe there are greater Nerves) and the hinder-part: becauſe at the ſides in the Os Ilion or Flank-bone.

In the three upper Cavities are engraven, where the *Oſſa Ilij* cleave to it.

Os

Os Coccygis the Cockow-bone, so called from the Shape it hath of a Cuckows-bill, is under the former, consisting of three or four Bones, and two Gristles. But I conceive there was a greater number of Bones and Gristles in that Danish Boy, who had a Tail growing out at his Rump.

The Os coccygis may be loosned.

Their Connexion is loose, and in Women looser then in Men, that they may give way.

1. In the Voidance of large Excrements.

2. In the time of Womens Travel, that the cavity may be more wide. And therefore some conceive that this Bone only gives way in the Birth, though *Pinæus* be against it, and that the Pains of Women in Travel depend upon the Concourse of little Nerves in that place. Afterwards in sitting it comes forwards, and of its own accord returns into its place.

This Bone in Men bends more inward to sustain the Intestinum rectum; in Women outwards, because of the Neck of the Womb, and that the Cavity might be wider.

This Bone being hurt or broken, exceeding great pains are raised, as the Stories related by *Amatus* and *Donatus*, do witness. *Hofman* believes it is of no use, but is only the mark of a tail, as the Nipples in Men are only the signs or marks of Duggs. But the constant Doctrine of *Galen* is, that all Parts of the Body are made for some Use.

Chap. 16. *Of the Nameless Bone, or Os Innominatum.*

The Os Innominatum or Nameless Bone, which some term Os Coxæ or Ilium, the Flank-bone, consists of *three Bones, Ilium, Pubis,* and *Ischium* joyned together by Gristles, till the seventh year it appears distinguished by a threefold Line, but in grown persons tis one.

The *Os Ilion* so called, because it contains the Gut Ilium, is the first part, which is the uppermore and broadest, knit to the Os sacrum, by a common membranous and most strong Ligament, although a Gristle also comes between.

Its semicircular and uneven Circumference, is termed *Spina Ossis Ilij*, whose inner part hollow and broad, is termed *Costa*, the Rib; the outer part formed with unequal Lines, is termed *Dorsum*, the Back.

Why the Os Ilium is larger in Women?

This Bone is larger in Women, and its Spine is drawn more out sidewaies, that the Womb of a Woman with Child may better rest upon it. And therefore women with Child do a little complain of this Part, as if it were pulled asunder from the Os sacrum and other neighbouring Parts to which it cleaves.

The Share-bones are loosned in Child-birth.

Os pubis or *Pectinis*, the Share-bone, is the second middlemore and foremore Part; which Bone is joyned to the Bone of the other side, by way of Sunchondrosis, that is to say, by a gristle coming between; which in Women is twice as thick and loose or wide as in Men, that these Bones in Childbirth may be (not dislocated or disjoynted, but) loosned and made to gape, when the Child strives to come forth. But now and then when the Childs greatness, or the narrowness of the place requires, the Share-bones are pulled asunder, as, besides the Authority of the Ancients, *Paræus* and *Riolanus* have observed in the Dissections of Childing-women, &c. and it is largely proved in the Anatomical Controversies of my *Father Bartholinus*: But this is not alwaies so, namely when the Child is soft and apt to bend it self and comply with the straitness of the place when the way is slippery, the Bones much widened, &c. for then the loosning of the Gristle does suffice.

But whether the Share-bones are moved is another question. *Joh. Cajus* affirms they are moved by help of the right Muscle of the Belly. *Spigelius* also saies they are moved after a peculiar manner upwards, whiles the Body roules in the bed, the Legs being lifted upwards. *Riolanus* proves that the Share-bones are moved, not alone, but with the Hip-bone, by help of the same Muscles, this I say he proves by the Venereal Embraceiments, in which these Parts are moved; by the going of such whose Legs are cut off, and lastly by dancing.

But some doubts do as yet make me scruple this Motion.

1. Because *Cajus* himself confesses, that the Share-bones (I add the rest) are not moved of their own Nature, but by the bending of the Back-bone.

2. These Bones being joyned together by Symphysis, can have no motion, which *Riolanus* himself confesses.

3. I have assigned another Use for the right Muscles, above in Book the first.

4. These seeming Motions of the Bones, are not proper to them, but are motions of the Thigh or Back, whose motion they follow. For in the Examples alleadged, any man may experiment in himself, that both his Thighs and Back are moved; also he may by his hand perceive, that both the Muscles of the Thigh called *Glutæi*, and the other adjacent Muscles are moved.

5. They ought to be immoveable, because the upper Parts rest upon them as on a Foundation, and we rest by sitting upon this Part.

In Women that have been lately delivered, these bones may be separated with the back of a thin knife, which they cannot be in others. Moreover, though the Share-bones are joyned by a Gristle, yet they have likewise two *Ligaments* 1. compasses them about circularly. 2. Is membranous, which possesses the hole.

Why there are great Holes in the Sharebones.

They are *thin*, and for highness sake furnished with very great *Holes*, which in women are more large and capacious, because of the Womb and Child, for the inner and lower Processes do bunch more outwards.

The Share-bones larger in women.

With the Os sacrum they constitute that Cavity which is termed *Pelvis* the Basin or Bowl, wherein are seated the Bladder, the Womb, and Part of the Guts.

Os Ischion or the Hip-bone is the third part, which is lower and more outward, wherein is a large and deep Cavity, (they call it *Acetabulum*, the Saucer, and *Pixis* the Box) to receive the large Head of the Thigh-bone, which if it fall out, either by reason of some internal humore, or outward chance, a Luxation or Semiluxation is thereby caused. The gristley Process of this Cavity, is termed *Supercilium*, the Brow.

The loweſt Parts of this Bone are more distant in women then in men, and therefore their *Pelvis* or Basin is larger then that in men.

This Bone is *knit* to the Os sacrum, with a double *Ligament*, growing out of the Os sacrum: The *one* is inserted into the sharp Process of the Hip, the *other* behind, into its Appendix, that the Intestinum rectum and its Muscles may be thereby sustained.

Chap. 17 *Of the Ribs.*

As the *Os Innominatum* or Nameless Bone, is at the sides of the Os sacrum, so at the sides of the Vertebræ of the Back, are the Ribs. And therefore, ascending in the Explication of the Skeleton, these are now to be explained, as being the lateral Parts of the Chest.

The

The FIGURES Explained.

TABLE V.

This TABLE preſents ſome of the Vertebræ, the Os ſacrum, Os innominatum, the Ribs and Shoulder-blade peculiarly, and their Particles.

FIG. I.

AAA. *The foreſide of the firſt Vertebra of the Neck termed* Atlas.
B. *The hole through which the Spinal Marrow deſcends.*
CC. *The tranſverſe or lateral Proceſſes.*
dd. *The lateral Holes through which the Arteries aſcend to the Brain.*
EE. *Two Cavities receiving the Occiput.*

FIG. II.

AA. *The back-ſide of the ſecond Vertebra of the Neck.*
B. *Its Appendix or Proceſs like a Tooth.*
C. *Its forked Spine.*

FIG. III.

AA. *The hinderſide of the Back-vertebra.*
B. *Its upper Surface, leſs ſolid and full of ſmall Holes.*
CC. *Its tranſverſal Proceſſes.*
D. *Its hinder Proceſs or Spina.*

FIG. IV.

AA. *The foreſide of the Vertebra of the Loins.*
B. *Its lower Surface, for the moſt part covered with a Griſtle.*
C. *An Hole for the Marrow to paſs through.*
DD. *The tranſverſe or lateral Proceſſes.*
E. *The latter Proceſs or the Spina.*
II. *Its oblique Proceſſes.*

FIG. V.

AAAA. *The hinder-ſide of Os ſacrum, conſpicuous by reaſon of its Knobs and Roughneſs.*
B. *The Hole for the deſcent of the Spinal Marrow.*
CC. *Its oblique Proceſſes.*
ddd. *Its hindermore Proceſſes.*
eeee. *Its Holes for the going out of the Nerves.*
ffff. *Its hinder Proceſs which is forked.*

FIG. VI.

Shews the *Os coccygis* or Crupper-bone, conſiſting of four little Bones or Griſtles.

FIG. VII.

Shews the Os Innominatum or Nameleſs Bone.

AA. *Os Ilium one part of the Nameleſs Bone.*
bbb. *The Spine thereof.*
C. *Its Back.*
DDD *Os Pubis the Share-bone, another part of Os Innominatum.*
E *Its large Hole.*
FFF. *The Os Iſchion or Huckle-bone, a third part of the Nameleſs Bone.*
GG. *The large Cavity or Saucer*
hh. *The Brim thereof.*
I. *The Knob.*
K. *The Appendix of the Huckle-bone.*

FIG. VIII.

AAA. *The Vertebræ of the Back.*
BBB. *The Ribs.*
CCCC. *The Cavity ingraven in the lower part of the Ribs.*
DD. *The two Knobs of the Ribs, by help whereof they are joyned to.*
E. *The Hollowneſs of the Vertebræ, and to the*
F. *Tranſverſe Proceſs of the Vertebræ.*
G. *The loweſt Rib, having a ſimple Knob.*

FIG. IX.

A. *The Clavicula or Channel-bone.*
b. *Its ſmall Head whereby tis joyned to the Breaſt-bone.*
c. *Its other end whereby tis joyned to the Shoulder-blade.*
D. *The Scapula or Shoulder-blade.*
E. *Its firſt Proceſs, called* acromion.
F. *Its leſſer, lower, and ſharp Proceſs called* coracoeides.
G. *Its ſhorteſt Proceſs called* Cervix *the Neck.*
hh. *The Baſis of the Shoulder-blade.*
i. *Its upper Corner.*
k. *Its lower Corner.*

The *Situation* of the *Ribs* in the Sides, and the Greeks call them *pleurai*, because they form the Sides.

In *Shape* they resemble a bow, or the lesser Segment of a Circle, that the Chest might be the larger. *Johan. Fontanus* found a forked *Rib*; and my self at *Hafnia* shewed the third *Rib* of the left side, as thick as two *Ribs*, joyned to the Breast-bone with two shanks.

At their rise they are narrower and rounder, but the nearer they come to the Breast, the broader they grow. In their upper part they are thicker. And the upper *Ribs* are more crooked, and also shorter; the middlemore are longer and broader; the lower are cut again shorter.

The *external Surface* is rough, where they are fastned to the *Vertebræ*, because the Ligaments which tie them do thence proceed: And there they are furnished with two little knobs: 1. Is articulated to the hollow of the Vertebra. 2. Is joyned to the transverse Process of the Vertebra. But the five lower are joyned by a simple knob.

The *inner* side is smooth, because of the Membrane *Pleura*.

In the lowest part there are *Cavities* according to the length of the *Ribs*; for the Vein, Artery, and Nerve; which appears the more, by how much they are nearer the Vertebra's.

An Admonition for Chirurgeons. Where let Chirurgeons observe in the opening of the Chest, which is made between the fist and sixt *Rib*, the Section must be made from the top towards the bottome, but not contrariwaies, least these Vessels should be hurt.

The *Ribs* have *Connexions*; one with the Vertebræ of the Back, another with the Gristles of the Breast-bone.

The Gristles of the Ribs. The *Substance* of the *Ribs*, is partly bony, and partly gristly.

1 That the Chest may more easily be contracted and distended.

2 That a Fracture may not easily happen.

'Tis *bony* in the part near the Back, and the lateral part.

Its *gristly* near the Breast-bone to which they are joyned.

For all the *Ribs* in the forepart, have Gristles like Epiphyses, which in women (not in men unless very old) through tract of time, do grow hard as bones, that they may more strongly sustain the Bulk of the Dugs resting upon them.

The Gristles of the upper *Ribs* are harder, because they are coupled with the bones of the Sternon or Brest-bone; those of the lower are softer, because they are joyned to Gristles. Moreover in its hinder part each hath a Gristle, which is articulated with a Vertebra.

Why the Ribs are many in number? The *Ribs* are many in *Number*, that the Chest may be more easily moved. *Pansanias* in his Relations of *Athens*, tell us, that *Protophanes Magnesius*, had his *Ribs* fastned one to another, from his shoulders to his bastard *Ribs*. *Nicholas Fontanus* saw three united and unseparable. For the most part they are on each side twelve, both in men and women. Seldome thirteen, more rarely eleven. But often there is only one superfluous. Tis therefore likely that in one side of *Adam* there were thirteen ribs, one of which *Jehovah* took out with the musculous flesh growing thereto and turned into *Eve*; or he had twelve ribs on one side, and eleven on the other.

How many Ribs Adam had.

The *Ribs* are divided into *true*, *genuine* and legitimate; and *bastard*, *adulterate* and illegitimate ribs.

How many true Ribs there are. The *true* are the seven upper ones, so called, because they do more perfect the Circle, and touch the Brest-bone, wherewith they have a perfect Articulation; and with the Vertebræ by a double knob as was said before.

The two uppermore are called *antistrophoi*, *retortæ*, turned backwards.

The two following are termed *stereai*, *solidæ*, the solid *Ribs*.

The remaining three are cal'd *sternitides*, the Pectoral *Ribs*.

The bastard Ribs. The five lowest are called *bastard Ribs*, because they are lesser, softer, shorter, nor do they reach to the Breast-bone (that dilatation may be there better made, at the beginning of the lower Belly) nor have they a perfect Articulation therewith, but being knit only to the Vertebræ; as if some part of them were cut off, they end into longer Gristles than the true ones: Which being turned back upwards, do stick one to the other, as if they were glewed together, the last excepted, which is the least, and sticks to none, and therefore tis truly spurious, that a larger space may be for the Liver, Spleen, and upper Guts being distended. Howbeit, the eleventh sometimes and the twelfth, are tied to the Septum tranversum: Sometimes, the last grows to the oblique descendent Muscle of the Belly, without the Midriff; sometimes it hath the Circumscription of its proper Muscle; which pulls it from.

The *use of the Ribs* is:

1. [Especially of the true ones] to defend the Breast and Bowels therein contained, as the Heart, *&c.*

2. To sustain the Muscles that serve for Respiration, and some others of the Belly.

[3. Of the bastard ones] to serve the Natural parts contained in the Belly.

CHAP. XVIII.

Of the Sternon or Breast-bone.

THe Bone of the Breast, which in the fore-part of the Chest rests upon the *Ribs*, and is spread thereupon (whence they suppose tis call'd *Sternum*) is by *Hypocrates* termed *Stethos*: which Word nevertheless sometimes signifies

1 The whole forepart of the Chest.
2 Its Pain.
3 The Breast-bone as in this place.
4 The Orifice of the Stomach.
5 The Sword-fashion'd Gristle.

Others call this bone *Os Gladiale* or *Ensiforme* the *Sword-bone* or *Sword-fashion'd* bone, because of the shape of a Sword or rather such a Dagger as was used by the Ancients: for it is *convex*, *long* and *broad*.

Its *Substance* is partly bony, but fungous and red, partly Gristly.

It consists of *divers bones*, not of one, as is commonly seen in old Men, the diversity of its bones appears, when you remove its Membrances. In Infants it is wholly gristly, excepting its first bone. Moreover, the upper bones are sooner made than the lower, and the middle parts, than the outmost: so that in conclusion, eight bones are found in the Breast of a Child, which after seven years grow together, and become fewer, so that in grown persons there are sometimes three, sometimes four, sometimes more bones. But the first and last remain in grown persons as in Children; but the middle ones growing together, the number of bones comes to vary in that place.

These Bones are distinguished by transverse lines, and are knit together by *Synchondrosis*; for the Gristles are interposed like Ligaments.

The *first* and *uppermost bone*, is large and thick, plain and uneven, of an Halfmoon fashion above, representing the joyning of a Dagger blade into the haft, some term it *Jugulum* the *Throat-pit*, others call it *Furculum* the little fork.

It hath on each side an *hollowness* in the upper part, to

receive the Heads of the Claviculæ or Channel-bones, in which copulation Gristles come between.

And another Hollowness within engraven in the middle, that it may give way to the descending Trachea or Wesand.

The *second* is more narrow and hath many hollownesses on each side to receive the Gristles of the Ribs.

The Cartilago Ensiformis.

The third is yet less, but broader than the second, and ends into the Gristle which is termed *Xyphoides* Sword-fashion'd, and *Mucronata* pointed, because towards the end it is sharp like the point of a Sword. The Arabians term it, the Pomegranate; *Avicen* calls it *Epiglottalis*, and the common name is *Scutiformis* Shield-fashioned.

This Gristle is triangular and oblong, sometimes round at the End, and sometimes broad, otherwhiles cloven, whence some call it *Furcella* the little fork; 'tis seldome double.

Sometimes 'tis *perforated*, for the Dug-veins and Arteries, which are accompanied by a Nerve. Sometimes in aged persons, it attains a bony Substance, *Vesslingus* hath found it a Fingers length not without great hurt to the Stomach, and trouble when a man bows himself. *Pavius* also saw here a bony Substance, in a person troubled with extream shortness of breath.

This if it be too much pressed and bowed inwards, the parts beneath it are hurt, *viz.* the Liver and Stomach, and the Infants perish for want of Nutriment: of which see *Cundronchius* and *Septalius*, *Zacutus*, *Wilhelmus Piso*. This Disease is by some Women cal'd, the Hearts compression.

Folius hath observed two Muscles placed on the side hereof, by which this Gristle is lightly moved downwards and inwards.

The Cavity appearing outwardly in this place, is called *Fovea*, or *Scrobiculus Cordis*.

The *use* of the Sternum or Breast-bone, 1. Like a shield to defend the Heart from external dangers.

2. To sustain the Mediastinum.

3. To collect the Ribs and fasten themselves one to another.

CHAP. XIX. *Of the Channel-bones and Shoulder-blades.*

THe Channel-bones are called *Claviculæ*, *Clavides* in Greek, that is the Keyes; because they shut up the Chest, and like Keyes do lock the Shoulder-blade to the Breast-bone, or because they resemble the Keyes used by the Ancients, which *Spigelius* saw in an old house at *Padua*. *Celsus* calls them *Jugula* a jungendo from joyning, others call them *Ligulas*, *Os furcale*, *Furcalem superiorem*.

They are *seated* athwart under the lower part of the Neck, on the top of the Breast, on each side one.

They have the Shape of a long Latine S, that is to say, of two Semicircles, set one to another contrariwise, at the Throat externally they are convex, inwardly a little hollowed, that the vessels carried that way may not be compressed. But in Men they are more crooked, that the motion of their Arms may be less hindred, in Women less, for beauties sake, seeing the hollows in that place are not so visible in Women as in Men, and therefore Women are not so nimble to throw Stones as Men are.

An hollowness about the channel-bone.

Their *Substance* is thick, but fistulous and fungous; and therefore they are often broken.

Their *Surface* is rough and uneven.

They are knit to the upper process of the Shoulder-blade (by a Gristle, which nevertheless grows not thereto, that it may give way a little in the motions of the Shoulder-blade and Arm, only it is detained by Ligaments embracing the Joynt) by a broad and longish head, and with the Sternon or Breast-bone, it is joyned, by another little head, as was said before.

Its *use* is to serve the sundry motions of the Arm, which because it rests upon this bone as on a prop, therefore it is more easily moved upwards and backwards. And therefore it is that Brutes have no channel-bones, excepting the Ape, Squiril, Mouse, and Hedge-hog or Urchin.

What the Scapula is.

Os Scapulæ the *Shoulder-blade* is by the Greeks termed *Omoplatæ* because it makes the breadth of the Shoulder, those that speak barbarously calls it *Spatula*. It is a bone broad and thin, especially in the middest, but in its processes thick, on each side one, resting upon the upper Ribs, behind, like a Shield.

Its *Figure* is in a manner triangular.

Its *Parts* are sundry. The Internal is hollow, the other part (which hath both a corner and an upper and lower Rib) is gibbous, which is termed *Testudo* the Tortoise, also the Back of the Shoulder-blade. There is also a certain Spine or sharp-point, looking above and beneath the cavities which are termed *Interscapulia*.

It hath three *Processes*.

I. Is the extream part of the Spine lately spoke of, and is called *Acromion* the *Shoulder-tip*, or *Summus Humerus*, whereby 'tis joyned to the Clavicula or Channel-bone.

II. Is lesser, lower and sharp, and from its likeness to a Crows bill, 'tis cal'd *Coracoides*; also *Anchuroides* from the likeness it hath to one part of an Anchor, also *Sigmoides* and by this process, the Shoulder bone is contained in its place.

III. The shortest is termed *Auchè* cervix, the Neck; in the end whereof there is a superficial cavity, whereunto the Head of the Shoulder is inserted, which that it may not easily slip out, the deepness of the Cavity is encreased by a thick Gristle, compassing the Lips. And by this process and Cavity, the Shoulder-blade is joyned with the Arm.

It hath five *Epiphyses*, three at the inside, and at the Basis near the carriage of the Spina. Two of them produce *Ligaments*, which joyn its head to the Shoulder, and the Shoulder-tip to the Clavicula. But common *Ligaments* thin and Membranous, do compass the Joynt of the Shoulder-blade and Arm.

Use of the Scapula or Shoulder-blade.

1. It serves to strengthen the Ribs.

2. For the Articulation of the Shoulder and Channel-bones, and for their security. And therefore the Shoulder is seldome (without very great violence) dislocated or disjoynted upwards, or to one side, but for the most part downwards, where no Shoulder-blade hinders.

3. For the implantation of Muscles.

4. Primarily for the action of laying hold according to *Hofman*, to which they are subservient, by inarticulation partly, and partly by the explanation of certain Muscles of the Arm.

5. Secondarily to cover the Heart.

CHAP. XX. *Of the Bones of the whole Arm and Hand.*

THe Bones of the Arm and Hand, are divided into the *Brachium* or Arm peculiarly so called, *Cubitus* the Cubit, and *Extrema manus* the Hand.

The *Os Brachii* or Arm-bone, is a single Bone, great and strong, long, round, and uneven. In its upper *part* it hath an Appendix or great *Head*, growing to it, which is round, covered with a Gristle, and articulated with the Scapula by *Diarthrosis*.

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The lower part is articulated to the Cubitus and Radius; where there are two *processes*; the *External* which is less and crusted with a Gristle; the *Internal* having two Hollows; representing a Pulley, whereby the Cubit being joyned by way of *Ginglymos*, may be bent to a most acute angle, but not extended beyond a right line.

The *Bones* of the *Cubit* are two, shorter than the Shoulder, and having Appendixes on either side, resting mutually one upon another, and joyned one to another by a Membranous Ligament.

The first being lower, greater and longer than the other; is termed *ulna*, *Cubitus*, by the barbarous Writers *focile majus*; the other being upper and lesser, is termed *Radius*, or *focile minus*.

The *ulna* or *Ell*, so called for some resemblance it hath to the Drapers Metwand termed an Ell, in its *upper* part is *articulated* with the Shoulder by *Ginglymos*, and therefore it hath there Processes, and Hollows.

The *Processes* are two, longwise shaped, and as it were triangular, rough, that the Ligaments might strongly close upon the Joynt and compass the same fast. They are termed *Corvini*, that is Beaks, Bills or Acorns. The *foremore* and uppermore is less, and goes into the hollow of the Shoulder: the *later* is thicker and larger and ends in an obtuse angle, and goes into the hinder hollow of the Shoulder. *Galen* calls it *Olecranum*, *Hippocrates Ancona*, the Latines *Gibberum*.

In the middest of these is a great Cavity or Hollow, like an half Circle, whence 'tis called *Sigmoides* from the letter Sigma so shap'd of old by the Greeks. It hath as yet another smooth external lateral Cavity, for the head of the *Radius*.

In the lower part it is articulated with the Wrist, both by a Gristle going between, as also by an acute process therefore termed *Styloides*, *Bodkin-like*; whence a *Ligament* arises, which fastens the Cubit to the Wrist-joynt.

The other Bone cal'd *Radius* is more oblique or crooked; and is a little distant from the other in the middle, where a thin *Ligament* comes between: but above, the Ulna receives the Radius; beneath, the Radius receives it.

The *upper part* thereof is articulated with the outward part of the *Brachium*, by way of *Diarthrosis*, whence proceeds the forward and backward motion.

The *lower* is articulated with an Appendix with the Wrist-bone, at the greatest Finger.

The upper part of *this*, is thinner, the lower thicker; contrary to what is in the former.

The *Hand* hath four sorts of *Bones*: those of the *Carpus*, *Brachiale* or *Wrist*; those of the *Metacarpus* or *post brachiale*, the *After-wrist*; those of the *Fingers* and the *Sesamus-seed-bones*.

The *Carpus* or Wrist, which the *Arabians* call *Rasetta*, hath *eight* distinct nameless *Bones*, very unequal, differing in *Shape* and *Magnitude*.

At their first original they are Gristles, afterwards they become Spungie Bones.

They are covered with very strong *Gristly Ligaments* and withall so fastned together, as if they were but one Bone.

And these Ligaments arising from the lower processes of the Radius and Cubitus, do serve for Articulation.

But there are other *Ligaments*, which are transverse and shaped like rings, for to strengthen and safely to carry along the Tendons, the *internal*, containing the tendons of the Muscles which bend the Fingers; and the *external*, containing the Tendons of the Muscles which extend the Fingers, which Ligaments or Bands, though they seem to be one, may be divided into many.

The FIGURE Explained.

This TABLE shews the Skeleton of a grown Body, that the contexture of the Bones may be seen one with another.

A. *The Bone of the Forehead.*
bb. *The Coronal Suture.*
C. *The Temple Bones.*
d. *The Teat-like production or Processus mammillaris.*
E. *The Os jugula.*
F. *The upper Jaw-bone.*
GG. *The lower Jaw-bone.*
hhh. *The Vertebræ of the Neck.*
iiiiii. *The Ribs.*
KK. *The Sternum or Breast-bone.*
LL. *The Claviculæ.*
MM. *The inner-side of each Shoulder-blade.*
NN. *The Arm-bone or Os humeri.*
OO. *The Head thereof joynting into the Shoulder.*
PP. *Its lower part articulated with the Cubitus and Radius where is*
qq. *The inward knob thereof.*
rr. *The outer knob.*
SS. *The Cubit bone called ulna.*
TT. *The other Cubit bone called Radius.*
uu. *The Process of the ulna, crooked backwards, which* Galen *calls* olecranum.
xx. *The lesser process of the ulna.*
YY. *The Wrist consisting of eight little Bones.*
ZZ. *The Metacarpus consisting of four Bones.*
αααα. *The Finger rows.*
ββ. *The Thumb compounded of three bones.*

These following Characters, do point to the lower Bones of the Skeleton.

Aaaaa. *The five Vertebræ of the Loyns.*
BB. *The inner side of Os Sacrum with its holes.*
CC. *The Cavity of Os Ilii, constituting a great part of the Pelvis or Basin.*
DD. *The Os Coxendicis with its Acetabulum or Sawcer.*
EE. *The Share-bones with their Holes.*
F. *A line knitting the Share-bones by help of a Gristle.*
GG. *The Thigh-bone.*
hh. *The round head of the said bone.*
ii. *The Neck thereof.*
kk. *The external process of the Neck, or the great Trochanter.*
ll. *The other process or less Trochanter.*
mmmm. *The lower heads of the Thigh-bone.*
NN. *The Mola, patella or Knee pan.*
OO. *The Tibia right and left, in which*
pppp. *Shews the two upper Hollownesses,*
rr. *Shews the Spina,*
ſſ. *The lower Process of the Ankle-bone.*
TT. *The Fibula or other Leg-bone so called, or the Perone.*
uu. *Its lower part constituting the external Ankle.*
XX. *Seven Bones of the Tarsus.*
δδ. *The Astragalus.*
β. *The Calx, Calcaneum or Heel-bone.*
ſ. *The Os cubiforme, Die-fashioned-bone.*
YY. *The bones of the Metatarsus.*
ZZ. *The bones of the Toes, of which two are reckoned to the Great Toe and to the other Toes three a piece.*

The

Place in here, The Skeleton of a grown body.

The bones of the Wrist are dispersed in a certain order: for above, there are four, articulated with the *Radius* and the Cubitus: beneath as many, knit to the four bones of the *Metacarpus* or After-wrist.

The *Metacarpium*, *After-wrist*, or *Palm*, hath four bones (others say five, reckoning the first of the Thumb amongst them) shaped longwise and small.

They are joyned to the Wrist by a Connexion of obscure motion, and by *Gristly Ligaments*: with the Fingers by way of *Ginglymos*.

These Bones are *fistulous* containing Marrow, hollow within, bossie without.

They have *Appendixes* on each side, which neer the fingers are round and longish heads, going into the hollowness of the Fingers. In the middle they gape one from another, where the Muscles cal'd *Interossei* do lye conceal'd.

The *bones* of the *Fingers* are *fifteen*, in each Finger three. For the first of the Thumb is reckon'd in this number, because it hath a looser articulation than the *post-brachialia*.

The row of Fingers on a hand the Greeks call *Phalangas*, because they resemble a rank of Souldiers in battle array.

Each of the Fingers have Ligaments on their insides, according to their length like Channels, whereby they are fastned one to another.

The bones of the Finger differ in *Magnitude*. For in every Finger, the first is greater than the second, the second than the third: and they are all thicker at the Joynt, where their knobs are termed *condyloi*, *nodi*, *knots*.

Without they are bunching, within hollow and plain the better to lay hold.

They have Processes above and beneath, besides the bones of the third Interjuncture, which they did not need above where they are joyned to the Nails.

CHAP. XXI.

Of the Bones of the whole Leg, Foot and Thigh.

THe Pes or Leg (taking the word in a large sence) is *divided* into three parts, as the Arm was: viz. into *Femur* the *Thigh*, *Tibiam* the *Shank*, and *Extremum pedem* the *Foot*.

Femur (the Thigh) is so termed *a ferendo* from bearing, because it bears and holds the Creature up, it consists of one only Bone, but the greatest and longest in the whole body, whose fore and external part is more bunching, the inner and hinder, more Saddle-shap'd.

A Memento for Chyrurgions. For it descends obliquely inwards unto the Knee; which Chirurgeons are to observe, lest in the Fracture thereof they come to disorder this situation.

The *upper part* hath three *Processes*, which are rather *Epiphyses*, and are easily sepaarated in young Children.

I. Is a most great and round Head, made of an Appendix, which is inserted into the *Acetabulum* or hollow Sawcer of the Coxendix, and is by a double *Ligament* fastned to the said Coxendix or Hip-bone: the *one* common, broad, membranous, but thick enough, compassing the Joynt round about; the *other*, round, as it were a Gristle (as if it were a Gristly Nerve) betwixt the head of the Thigh and the Depth of the Cavity, least the head of the Thigh fall out.

The *Neck* hereof hath a double *process* furnished with an Appendix, which Appendixes are easily pluckt asunder in Infants, but not in grown persons.

II. Is external, which is called *Magnus Trochanter* or *Rotator*, the great whirler or wheeler about, having hollows, Impressions, and Lines.

III. Is internal, cal'd *parvus Rotator*.

Whose *use* is, for the original and Insertion of those Muscles by which the motions are caused: and therefore also it is, that they are called *Trochanteres*, Wheelers or Whirlers about.

The *lower part* is articulated or joynted with the shank by way of *Ginglymos*. For at the Knees, with a double head, the inner more thick, the outer more broad and flat, it enters the Cavity of the Tibia; between which heads there is a large space, of a Thumbs-breadth, through which the vessels do pass unto the Thighs with a Nerve of the fourth pare; and wounds in this part are dangerous, by reason of Convulsions.

Mola so called from its likeness to a mill-stone; is a round and broad Bone; it is in this place put upon the joynting of the Thigh and Shank, where the Knee is compas'd with a membranous Ligament, all save the *Mola*; others call it *Rotula*, *Patella*, *Mola*, *Scutum*, *Os scutiforme*, *&c.* the Knee-pan, because it constitutes the Knee.

Its *Substance* for some months in young Children, is Gristly, in grown persons it becomes bony.

Its *shap'd* like a Buckler, for in the middle, one part thicker than the rest, bunches out.

It grows to, and is fastned by certain thick Tendons, of some Muscles of the Thigh.

It is *movable*, and for to make the motion more easie, inwardly at the Thigh-bone, 'tis cover'd with a slippery Gristle.

Its *use* is: I. To strengthen the joynt in that part, lest the Thigh should slip and be dislocated inwards, and so a man shall fall, especially walking downwards, and much bending his Knee. 'Tis reported, that in *Nova Zembla*, Men bend their Knees as well backwards as forwards.

II. To defend the Tendons of the Muscles.

Tibia the shank, being that part which is between the Knee and the Ankle, consists of *two Bones*, as the Cubitus or lower half of the Arm.

The *one* being inner and greater, is called by the name of the whole, *Tibia*, *Cnéme*; by some *focile majus*, *canna major*, *&c.* In an Elephant alone of all Creatures (as *Bonitus* informs us) there is a bending or joynting in the middle of the Shanks, besides the other ordinary bendings common to all Creatures.

In the *upper part* it hath a *Process* in the middle received by the Cavity of the Thigh-bone, and two cavities framed long-wise, for the Heads of the Thigh-bone; the depth of whose Hollows is encreased by a Gristle, fastned thereto by Ligaments, which is movable, soft, slippery, and smeared with an Oyly moisture, thick in its circuit, thin towards it Centre, and therefore termed *Lunata*, Moon-shap'd.

A *knob* growing there, doth separate the two *Cavities*, from the top whereof a strong Ligament proceeding, it is fastned into the hollow of the Thigh-bone.

But from the fore and rough side come two Ligaments, which encrease the Moon-fashion'd Gristles.

Its *foremore* part which is sharp and long, is termed *Spina*, where the shape of the Bone is as it were triangular, and so acute that it is like the edge of a Knife, and therefore if the Bone of the Tibia or shank be strucken on this forepart, it causeth exceeding pain, because the neighbouring Skin and the Periosteum are cut by this sharp Bone as it were with a Knife.

In the *lower part* there is a *Process* void of flesh, sticking out with a bunch, near the Foot, and 'tis cal'd *malleolus internus*, the inner Ankle-bone; as the process of the Fibula, is termed *malleolus externus*, the outer Ankle-bone.

Fibula perone, the *Button*, because it seems to button together and joyn the Muscles of the shank; is also cal'd *Sura* the Calf, *Canna minor*, *Focile minus*, *&c.* and it is a smaller and lanker bone, drawn along before the Tibia without, as the *Radius* before the Cubit.

In the upper part, its round head doth not touch the Knee, but it subsists beneath: but *with its lower part*, it goes beneath the Tibia, and therefore 'tis as long a bone as the Tibia is.

In

In the middle the Tibia and Fibula hold a gaping distance one from another, by reason of the Muscles of the Feet there placed, in which space a thin broad *Ligament* joyns these Bones together, according to their longitude, 'tis joyned also to the Tibia, by a common Ligament, above and beneath.

Beneath, the Head becoming sharp, hath an *Appendix*, which growing thick, begets a process called *Malleolus externus* the outer Ankle-bone which is lower than the inner Ankle-bone.

The *Bones of the Foot* are divided as the Bones of the Hand, into three parts: into the *Tarsus*, *Metatarsus*, and the Toes.

The Bones of the *Tarsus* are *seven*, though some number only the last four to be in the *Tarsus*, because the three first have no Bones in the Hand answering to them.

I. It's cal'd *Astragalos*, in Latine *Talus*, and commonly *Os Balistæ* the Sling-bone, also *Quatrio*, because of its four sides.

'Tis placed beneath the shank bones as a Basis or foundation: for it is joyned with the Appendix of the Tibia by way of *Ginglamos*; wherefore they have upon a long Neck, an high, round, and smooth Head, covered over with a *Gristle*, in the middle whereof is a smooth *Cavity*: whereupon it comes to have on each side a brim or brow, like a pully or little wheel on which a Rope runs.

At the sides it receives on each hand the Ankle-bones: it's also joyned with the *Os naviculare*; also below to the Heel, with a double joynt, where its lower part is uneven, twice hollowed, and thrice bunched. It receives the Head of the Heel-bone.

In the middest of these Joynts a *Cavity* is to be observed (to which the hollow of the Heel answers) wherein is contained fat and a slimy substance, to moisten the gristly Ligaments, which knit the Talus to the Bone, least in their motion they should be dried. Hence I have observed as often as there is scarsity of this moist and fat Substance or none at all, either by means of a wound in that place, or any other cause, that there is a noise in a mans Foot when he walks, by the knocking of the two bones one against another, yet without pain, because there is no sensitive part within, but only Bones, Gristles and Ligaments.

II. Is the greatest and thickest in the Foot, as being the chiefest stability thereof (as the Talus is chief for motion) and therefore 'tis joyned by many Ligaments to the Talus or Ankle, and other adjacent Bones

'Tis called *Pterna calx*; *Calcaneum*, *pedis calcar*, the Spur of the Foot or Heel-bone, into which the greatest and strongest *Chord* or Tendon in the whole Body is fastned, being made up of the Tendons of three Muscles of the Foot.

Its *lower part* is somewhat broad, where it turns backwards, that the Foot may more firmly be setled and strengthned, otherwise a man would easily fall backwards.

In its upper part, it hath a large head, going into that shallow cavity which receives the knob of the Talus. But it is also joyned to the *Os Cubiforme* or Die-fashion'd bone with its flat head.

III. Is called *Os naviculare*, *Scaphoeides* from the similitude of a Boat: 'tis knit to the Talus and the three hindermore bones

IV. From the form of a *Die* or four square solid body called a Cube, is termed *Cubo-eides* cube-fashion'd, also *Os tesseræ*, the Dice-bone, by the Arabians *Grandiosum*, by some others *Polymorphos* many shap'd or many-fac'd. Being greater than the rest, 'tis *placed before* the Heel, *joyned* by an uneven Surface; with its other side 'tis joyned to the fourth and fift bone of the *Pedium*; but within, to the seventh bone of the Tarsus.

The other three, anciently without names, cal'd by *Fallopius*, *Calcoidea*, *Cuneiformia*, wedg-shion'd, are articulated to the *Naviculare* or Boat-fashion'd-bone: and they are greater or middlesiz'd, and a lesser from a broad Basis growing by little and little smaller and smaller.

The *Bones of the Metatarsus* or Sole, are *five* knit to the Bones of the Tarsus; *those of the Toes* are *fourteen*; because the great Toe is made up only of two Bones, and the Interjunctures are shorter than in the Hand, but those of the great Toe, thicker than in the Hand.

The other are like the Bones in the Hand which answer to them; as the Ligaments also commonly answer.

But under the sole of the Foot, the Skin and Fat being removed, there is a *Ligament* broad and strong; and from the lowest Bone of the Heel *Sesamoidean* little bones are inserted into all the ranks of Toes, for the greater firmness of the whole Foot.

Chap. XXII. and last.
Of the Sesamoidean Bones.

IN the Interjunctures of the Hands and Feet are found certain very little Bones called *Sesaminis* or *Sesamoidea* because they answer in likeness to Sesamus Seeds and also in their smallness.

Their shape. They are *round* and a little flat.

Magnitude. They are less in the Feet than in the Hands, excepting in the great Toe, because it is greater than the Thumb is. In ancient persons they are greater and a little plane.

Situation. They *grow* to the Tendons of the Muscles which move the Toes; under which they lie concealed wrapt up in the *Ligaments*; so that they come away with them in the cleansing of the Bones, unless great Care be used.

Sometimes they are gristly, as in Children, in which they are not very conspicuous; otherwhiles bony, covered with Gristles, and inwardly Spungy and porous.

They are commonly twelve in number in each Foot and Hand, but sometimes sixteen, nineteen, twenty and more; sometimes there are only ten. They are more in number, greater and harder, in the inside of the hand than without, in which *Riolanus* saies there are none. Their number therefore is uncertain: for many are so small that they are not observed: and Nature herein as in a matter of small moment, sometimes abounds, and sometimes again comes short.

But *those two* are chiefly remarkable for their greatness which are joined to the first Joynt of the great Toe, at the Head of the Bone Metatarsus; one which is the greater, placed under the Nervous part of that Muscle, which bends the first Bone of the great Toe, and the form and size thereof, is like the half of a great Pease, the white skin being taken off: which little bone is by the Arabians called *Albadara*. Some Ancient Philosophers held that a Man should grow up again at length from this bone, as from a Seed, which *Corn. Agrippa* from the tradition of the Hebrews calls *Luz*. But another much less, is placed under the second Joynt of the great Toe.

And though most commonly these same very small bones are found in the Interjunctures of the Fingers and Toes, yet are they to be seen also in other places.

As sometimes in the outside of the Hand, where the eighth Bone of the Wrist is fastned to the bone of the Metatarsus which sustains the little Finger, there is one which fills an hollow place there: and after the same manner here is the like Bone in the Tarsus of the Foot, at the outside of the articulation of the fift bone of the Metacarpus which sustains the little Toe, with the *Os cubiforme*, or Die-fashion'd bone: also two little bones in the Ham by the *Os femoris*, which grow not in the Tendons, but in the Beginnings of the two first Feet-moving Muscles, which are found in old Men and in dry Creatures, as Deer, Dogs, and Hares. Hereunto they refer that bony part in aged people, which is placed against the *Os Cubiforme*.

Their *use* is.

I. To defend the Tendons, and by their hardness to retain them in their motion, least they should fall from the Joynt when it bunches out.

II. To strengthen the Joynt and preserve it from Luxation.

III. To fill up empty spaces. And while these things are performed by the said little Bones, the Hands do thereby lay firmer and safer hold upon any; and the Feet can stand and go more steadily, especially on rough ground.

To God our Creator be Praise, Honour and Glory, who hath form'd and fashion'd us so wonderfully.

FINIS.

TWO EPISTLES OF Johannes Walæus Concerning the Motion of the Chyle And the BLOOD. TO Thomas Bartholinus The Son of CASPAR BARTHOLINUS.

THE FIRST EPISTLE Concerning the Motion of the Chyle and Blood, TO

To PARIS. } *Thomas Bartholinus* the Son of *Caspar*-

THE chief men in Church and Commonwealth have in all Ages contended about Primacy: but learned Men have in no Age more ambitiously striven who shou'd seem most learned, then at this present time. And to attain their desire very many are not afraid to assist themselves by Calumnies and other worse Arts. No man can publish in Print, or communicate to his Friend any writing, which some account excellent, but he presently meets with a Detractor who will prick, cut, and tear him most cruelly. Now for a man to seek nothing else by his Cares and Labours, but Envy and Vexation of Mind, is extream madness.

These

Theſe Cauſes have (I confeſs) hindred me from ſatisfying your frequent Requeſt; and beſides, becauſe I am not willing to determine of thoſe things, which long experience of years cannot either prove, or ſufficiently limit. Howbeit you continue your Requeſt, and I am much aſhamed, alwaies to deny you. Alſo a certain learned Man hath impoſed a neceſſity upon me, in a manner, to diſcover to others my opinion concerning the Motion of the Blood. For certain Theſes having been diſputed concerning the Motion of the Blood, my ſelf being Preſident of the Diſpute; though the Defendant truly profeſſeth in his ſaid Theſes, that they are his own, yet he hath undertaken to tax and blame them, as if they were mine. And although that young man need not be aſhamed of thoſe Theſes, yet I would not have another mans Theſes, though diſputed when I was Preſident, to be accounted mine. Neither can he be ignorant of the Reaſon, who is acquainted with my Liberty in Diſputing, or the Cuſtome of our Univerſity.

The occaſion of this writing

Now therefore take my Opinion of the Motion of the Blood, as follows.

That ſome hot blood which leaps out of the great Arteries being opened is thinner, more rare and of a more bright colour, than that which flows out of the Veins when they are opened: yet, I will not therefore ſay, that the Arterial Blood differs formally from the Venal, Blood: for the Arterial Blood may differ as aforeſaid from the Venal, becauſe it comes reaking hot as it were from the fire, and abounds with greater ſtore of Spirits, as we ſee boyling Milk differs from it ſelf being cooled, for the ſame reaſon: for that Blood which is in the ſmaller Arteries, and ſo farther from the Heart, is obſerved to differ leſs from the venal Blood. And when we have taken Blood out of the greater Arteries, yea, out of the Heart it ſelf of a living Creature, and from the ſame Creature, have taken ſome out of the Veins, and have let them both grow cold and congeal, we could never obſerve any difference betwixt them. So that we can ſee no other, but that the Arterial Blood is of the ſame kinde with the Venal.

What Blood it is which is moved?

Some few will have, that the venal Blood is of two kinds, one which is contained in the *Vena cava*, another in the *Vena porta*. But we cannot ſee any difference of theſe Bloods either when they are included in their veſſels, or when they are let out: and that Reaſon doth teach as much we ſhall ſee anon.

Beſides theſe, we may likewiſe conceive another ſort of Blood, which being made of Chyle in the Liver, hath not received any further perfection in the Heart. And we are little concerned to know the Nature thereof, becauſe we ſee it continues ſuch but a very little while. So that we are to enquire into the motion of *only one ſort of Blood*.

That it is only one kinde of blood.

Now the Blood may be *moved* either *in that part of the Vein* or *Artery wherein it is contained*, or *out of that part into another*.

In *one part of a Vein or Artery*, the Blood is not diſcerned to move up and down, like boyling water, neither when it is received into a Veſſel, nor when let out of a living and hot Body; nor yet in the Artery it ſelf, if it being on either hand tied, ſhall be opened in the upper part betwixt the two Ligatures. Yea, when we have many times cut off the point of a living Heart, and ſet it upright, we have found the Blood to be hot, but never to boyl.

It is not moved up and down in the Veſſels like boiled water.

But that the Blood is moved *from one part of an Artery or Vein into another*, is a thing very manifeſt. For Blood is contained in the Veins of the furtheſt parts of the Body, which ſeeing it is not bred there, it muſt needs come from ſome other place. And it is evident enough, that in living Creatures, the Blood flows out of the *Vena Cava* into the Heart and out of the Heart into the *Aorta*.

But it is moved out of one part into another.

But that this ſame *whole Motion of the Blood* may be by us the better underſtood, I conceive our beſt way will be to begin *at the very Fountain*, and Original thereof.

which motion perfectly to underſtand, the motion of the Chylus muſt be ſought into.

I have often ſeen ſolid *Meat* in Dogs hold the ſame order in the Stomach, juſt as it was eaten by the Beaſts; unleſs the Stomach being diſtended with too much Drink, did make the Meat to float, and ſo to change its order and ſituation.

The Meat which the Stomach receives, although it be but two ounces, it evidently imbraces the ſame round about; juſt as we ſee folded purſes contract themſelves about a Bullet or round Ball within them, alſo the upper and lower Orifice are both ſhut: which by making an hole near the ſame, and putting in your little finger, it is eaſie to try. But the lower Orifice notwithſtanding, when we finde it perfectly ſhut, ſeems rather to be fallen together, than ſtraitly cloſed, that upon the ſmalleſt preſſure it may let the Chylus paſs by. Alſo many times when the Stomach and its Orifices are weak, they fail in their natural cloſeneſs, and upon ſearching are found looſer.

That meat which is firſt eaten hath the firſt place in the Stomach.

The Stomach cloſely embraces the ſame.

The meat retained in the Stomach, as thoroughly moiſtened with the Liquor of our food, Drink and Spittle: and it quickly becomes porous and Spungie: becauſe as is moſt likely the ſaid Liquor hath drawn out and ſuckt into it ſelf ſome of the ſubſtance of the Meat.

It is moiſtned with the moiſture of the Stomach.

A while after it is cut and torn as it were into very ſmall particles, both that of thin and that of groſs Subſtance, yea, in Dogs the very ſhells themſelves of Eggs: which doth queſtionleſs proceed from ſome acid ſharp humour that hath in it a diſſolving power. So we finde by experience that the Stomach burthened with the quantity or groſſneſs of meat, doth find it ſelf eaſed, by taking a little Vinegar, Juice of Citrons, Oyl of Sulphur, or Vitriol. Nor let any man aſſign the Cauſe thereof to Spittle or Choler belching back into the Stomach, when he ſhall ſee Bread ſteeped ſome hours in hot Spittle or the Gall of an Ox, by them not diſſolved, moreover in an hundred Dogs or more which I have cut up on purpoſe alive, I found Choler flowed back into the Stomachs of onely two of them, one of which had eaten nothing for three daies, and in his Stomach, which was wonderful to behold, there was a Cholerick froath ſo thick and full of bubbles, as that we ſee on the Suds of ſuch as waſh in Lye.

It is cut and minced by an acid humour.

Now I conceive this acid humor comes from the Spleen into the Stomach, becauſe there is no other part in the body which we can perceive to be ſharp or acid: and becauſe upon ſwallowing a bit of boyled Spleen eſpecially of a Sow, heavineſs of the Stomach proceeding from the Quantity or groſſneſs of Meats, is thereby holpen.

Which comes from the ſpleen.

Thus the Meat being mixed in its ſmalleſt particles with the Liquor, in tract of time by concoction it comes to the conſiſtence of thin Barley-cream: which when it hath attained, then at laſt it is thruſt into the Guts.

Afterwards it is changed into Cream.

Howbeit all Meat doth not receive this change in the Stomach in the ſame ſpace

Som ſooner, ſome later.

ſpace of time; it is ſooner performed in the day time, with a little meat thin of Subſtance and well chewed; it requires a longer ſpace in the night, where there is ſtore of it, the meat is groſs, and ſwallowed down in great bits: ſo that the meat which is well grinded with the Teeth, begins to be turned into Cream, when that continues yet ſolid, which was ſwallowed down in great bits.

How ſoon or late it is concocted and diſtributed.

Milk and Broaths in the day time are perfectly digeſted in an hours ſpace or ſooner, and if ſomewhat elſe hinder not, they are then alſo diſtributed; which the voiding of Urin alone, after them, doth evidently ſhew, without any Diſſection: Herbs are more ſlowly changed. Bread in reſpect of Digeſtion ſeems to be of a midling Subſtance, we finde in the firſt hour and half very little changed; in the following hour it is rare and light, juſt like a wet Spunge; when that hour is paſt, it is divided into very ſmall particles, and mixt ſo with the Drink, that all appears liquid, and ſoon after it is moſt of all digeſted, and at laſt as much of the Braad as is digeſted, between the fourth and fifth hour after its eating, is by the Stomach forced through the Pylorus, into the Guts. But ſome of the ſaid Bread ſtaies behind, which by little and little is perfectly digeſted, as alſo if any other meat were eaten with the Bread of harder digeſtion than it: which meats I have obſerved to be digeſted in this order. Firſt Beans and Peaſe, then Fiſh, then Fleſh which is perfectly digeſted and thruſt out of the Stomach between the ſixt and ſeventh hour: Beef between the ſeventh and eighth: yea, and the membranous parts of the Animals are longer in digeſtion, as alſo the ſhells of Egs; I have ſeen Bones that have abode in the Stomach unto the third day, during which ſpace they were become like Griſtles.

All at once or by piecemeal.

Yea, and in the parts of theſe very meats, oft times great variety is ſeen, as of Bread and Fleſh, though they ſeem whole in the Stomach, yet ſome portion though very little, is diſtributed ſometimes the firſt hour, unto the Milky Veins.

So that whatever is digeſted, doth not at all expect the digeſtion of the reſt, nor is ſtaid by that which is undigeſted, but preſently ſlips out, and is carried into the Guts: yea, and you ſhall ſeldome finde a Dogs Stomach empty, although he have not eaten in ſixteen hours before.

Now I could eaſily make all theſe Obſervations in Dogs, which I cut up alive, at ſeveral diſtances after they had eaten their Meat.

Being digeſted it is diſtributed into the Guts and milky Veins.

In the Guts the *Chyle* is of an Aſhe-colour, and is ſeldome coloured by the yellowneſs of Choler: and preſently now from the Duodenum it begins to enter the milky Veins of *Aſellius*, nor doth this entrance ceaſe in any of the Guts as long as any Chyle remains in the ſaid Guts, ſo that the *Inteſtinum rectum* or Arſe-gut it ſelf, is endued with milky veins, which are many times ſeen to look white by the afflux of Chyle. And

See the Figure of the milky Veins, pag. 563.

that we may not think that ſame milkie juyce comes elſewhere than from the Guts, I have bound theſe milky Veins inſerted into the Body of the Guts, and obſerved that from the Cavity of the Guts to the Ligature they are evidently full and ſwoln, but from the Ligature towards the Meſentery they wax empty and fall in.

Not through the Meſeraick veins

But the Chyle hath never been obſerved to enter into any Vein in the body of the Stomach, nor any Meſeraick Vein, nor yet the Blood being by the binding of *Vena porta* (whereof the reaſon ſhall hereafter appear) exceedingly augmented in the Meſeraick Veins, hath ever been ſeen to enter into the milky Veins. So that I cannot ſee otherwiſe, but that Nature hath ordained the milky Veins only to carry Chyle, and the Stomach and Meſeraick Veins only to carry Blood.

Alwaies white.

The Chyle in the milky Veins is alwaies though it proceed from Aſh-colour'd Chyle in the Guts or ſuch as is dyed yellow by Choler.

By one Continued paſſage of the milky veins.

By theſe Milky Veins the Chyle goes upwards, after what manner, is not very eaſie to ſay. This ſeems to me moſt probable, which I obſerved in great and lean Greyhounds; that ſome of the milkie Veins do go right on, to the *Ramus Meſentericus*, ſome into the *Vena porta* it ſelf, others into the hollow parts of the Liver, and very few do ſometimes end in the *Vena cava*, near the Emulgents. For theſe Animals have not that ſingle kernel in the beginning of the Meſentery, which *Aſellius* hath termed Pancreas, and which is wont to obſcure the paſſage of theſe Veins; but they are furniſhed in that place with ſmaller kernels, for the moſt part five in number, which being diſtant by a manifeſt ſpace one from another, through that ſpace they afford free paſſage to ſome milky Veins. But ſeeing that above theſe kernels, there are fewer branches of the milky Veins (and ſome of them greater) than beneath, I am apt to believe, that neer thoſe kernels, the milky Veins are divided into branches, and that the ſaid kernels ſerve, as elſewhere in the body, to accomodate the divarication or branching of Veſſels.

Not to the Spleen.

Sometimes alſo I have been ſhewed milky Veins, which entred into the Liver, but when in the preſence of the Shewers, I accurately examin'd the matter, we found them to be Nerves.

But to the Liver.

The Chyle being carried through theſe milky Veins is mixed with the Blood in the *Ramus Meſentericus*, in the *Vena porta*, and in the very *Liver* alſo it ſelf: for in what place ſoever you tie the milky Veins, they alwaies ſwell, becauſe they are hindred from paſſing the Chyle to theſe parts, and the Ligature being looſed, they manifeſtly infuſe the ſame into thoſe parts.

The Branches of the *Vena Porta* in the Liver although in ſundry places they are knit to the branches of *Vena Cava*, yet are they never opened into a great branch of *Vena Cava*, but the ſmalleſt branches of *Vena porta* do transfuſe this Chyle mixt with Blood into the ſmalleſt branches of the *Vena Cava*; as is eaſie to obſerve in the Liver blown up when the Fleſh is taken off, and it ſwims in water. And that the ſame happens to the reſt of the Chyle mingled with the Blood, will be hereafter manifeſt. Out of the little branches of the *Vena Cava* in the Liver, the Blood is in the Judgement of all men poured into the *Vena Cava*: and when in live Anatomies it is tied above the Liver, it manifeſtly ſwels with blood flowing in.

Out of the Liver into the Vena Cava.

Out of the Vena cava into the heart.

Out of the *Vena Cava* it enters into *the right Ventricle of the Heart*, and either part of the *Vena Cava* being tied, either that which is ſeated above, or that which is below the Heart, I have many times obſerved, eſpecially in an Eell, that it is quickly emptied towards the Heart which alſo *Harvey* hath obſerved chapter tenth of his Book.

Out of the right Ventricle of the Heart into Vena arteriosa.

Out of the right Ventricle of the Heart, it enters manifeſtly enough into the *Vena arteriosa*, and by it into the Lungs.

But I dare not ſay that any of the blood paſſeth out of

of the right Ventricle of the Heart, by the partition wall, into the left Ventricle thereof, seeing I find open passages elsewhere, but none in this place. *Petrus Gassendus* a General Scholar and of a candid Spirit, in his Exercitations upon *Fluds* Philosophy part 3. chap. 17. relates how he had seen *Payanus* shew the Partition wall of the Heart to be transpassable, by sundry crooked and turning passages: and that they might be found out, if putting a Probe gently into one of the pits, you shall most leasurely thrust it upwards and downwards and to one side, and still seek a further passage till you meet with the end thereof. And the truth is I have divers times found it to succeed as he saies; but I have withall observed, that those waies and turning passages, were not at all made by Nature, but by the Probe or point of a Penknife, while we open a way already made, and seek one farther: for the Flesh of the Heart is so tender and withall so consistent, that with the smallest touch of any thing that can bore, it is presently broken, and leaves a Cavity; so that we may also after this manner, find passages through the sides of the Heart.

But not through the Septum intermedium or partition of the Heart

That the Blood being entred by the *Vena arteriosa* into the Lungs, doth return through the *Arteria Venosa* unto the *Left* Ventricle of the Heart, I do hereby collect, in that having bound the greater branch of the *Arteaia Venosa* (in a live Anatomy) neer the Pericardium or Heart-bag, we have seen it grow hard and swell towards the circumference of the Lungs, that part being emptied and falling in which looks towards the Heart, and when the Ligature was loosed, we saw the Blood move to the left Ventricle of the Heart: and this is very easily observed in Rabbits. Now this Blood, because it can come from no other place, must needs come from the *Vena arteriosa* hither.

Out of the Vena arteriosa into the Arteria venosa and the left Ventricle of the Heart.

Leonardus Botallus a most learned Man, at the end of his Book *de Catarrho*, supposeth he hath found another way, by which the Blood may continually goe, out of the right, into the left Ventricle of the Heart. *A little above the Coronal Artery* (saith he) *I found a passage visible enough, near the right Earlet, which goes immediately and right forth into the left Earlet.*

This passage unless it be the progress of the *Vena cava* to the *Vena arteriosa*, which we call *Foramen ovale*, or another passage which I have sometimes found in a Sheeps Heart, as big as a Wheat straw, going with a crooked passage from one Earlet to another; unless, I say, it were one of these, I know not what for a passage it was.

But not through the foramen ovale.

And as for that *Ovale foramen Eg-fashion'd-hole*, it is not every where alike shut up, and oftentimes there is a very thin and transparent little Membrane growing in the middle thereof, which with the smallest touch of a Probe is easily broken, but it is very seldom upon any occasion found open, in grown persons. And the Blood flowing through the *Arteria Venosa* out of the Lungs, doth fasten the Membrane placed before that hole, so that even when it doth not grow to, hardly any thing can pass that way.

But that same oblique passage which I have seen in a Sheeps heart, doth many times pierce deep into the substance of the Earlet, but is very seldom carried into the other Earlet. And I conceive it was given the Earlet for its Nutrition, it not being wont to receive branches from the *Coronaria*.

Now from such things as seldom happen, we cannot conclude any thing touching those things that constantly come to pass: for Nature frequently sports her self in the Fabrick of the Heart. So in the *Septum Intermedium* or partition wall of an Oxes Heart, in the upper part according to the length of the Heart, sometimes I have found a Cavity, opening at the left Ventricle, about the point, which was as long and large as a mans Fore-finger. The like whereunto possibly *Aristotle* saw, when in his 3. *de partibus* Chap. 4. he saith the greater sort of Animals have three Ventricles in their Heart. For the greatest Animals that are, have but two Ventricles, as I observed in the Dissection of a young Whale.

So that the Blood cannot be thought to go ordinarily any other way, then through the Lungs into the left Ventricle of the Heart.

And thence into the Heart, the Arteria aorta, and the rest of small Arteries.

The Blood being thus caried into the left Ventricle of the Heart, goes from thence to the *Arteria aorta*, the middle and smallest Arteries: for they being bound in living Anatomies, do wondetfully swell towards the Heart, and towards the extream parts they fall in, and the Ligature being loosed, they evidently send the Blood to the remoter parts of the Body.

Out of the Arteries the Blood by common mouths.

The Blood out of the smaller Arteries may enter into the Veins; for the Arteries have a way open into the Veins, by the common mouths of one opened into another. And to the intent we might be sure that Blood may pass by those mouths, we have freed the Vein and Artery in the Foot of a dead Dog, from such things as are wont to hinder their being seen, and we emptied the greater crural Vein, and bound it in the flank, least any Blood might flow in that way, and in the Knee we bound both this Vein and its neighbouring Artery: and then with our fingers we forced the Blood in the Iliack Arteries, as far as to the Knee, and so we emptied the crural Artery, but the crural Vein we saw manifestly repleniished; and seeing into the Vein tied above and beneath nothing could come or a very little out of its branches and yet it was much filled, and the Artery quite emptied; we did gather that the Blood wherewith the Vein was filled, was driven by the little mouths out of the emptied Arteries, into the said Vein.

Known to the Ancients.

And that this Opinion is not new *Galen* himself shews in his 5. chap. *de Usu pulsus*. *The Conjunctions of the mouths of the Veins and Arteries are not visible to our Eyes: and if you shall justly refuse to believe them as not credible enough, you may be brought by other reasons delivered by the Ancients to believe there are such things: and not a little by this plain token, that in case a Man shall take any of those Creatures in whom the Veins and Arteries are manifest, as an Ox, an Hog, an Ass, an Horse, a Sheep, a Bear, a Libard, an Ape, or a Man himself, and open many large Arteries in the said Creature, he may draw all the Blood in its Body out through the said Arteries. I have divers times experimented the same, and finding alwaies that the Veins are emptied with the Arteries, I did perswade my self thae the Opinion was true concerning the common mouths of the Veins and Arteries, and of the common passage of the Blood from one to another.* Yea it is a received and common opinion, that the Arterial blood doth naturally enter into the smallest Veins, to the end that the part might be nourished with arterial and venal Blood.

Goes into the Veins.

And that indeed and in truth the Blood doth naturally pass in living Creatures, out *of the Arteries* into the *Veins* by those little mouths, these signs do cleerly witness.

As the store of Blood sent into the parts doth shew.

He that in living Dissections shall consider that Quantity of Blood, which by the Arteries is conveighed to the parts and Veins, can hardly perswade himself to think, that it is all consumed in nourishing the parts: especially if he shall consider that the Arterial Blood is thick enough, and not a fourth part thinner than the Venal blood, as I have often observed, when I have suffred both of them to grow cold and congeal, whence

we may justly conclude with *Harvey*, that the Blood which is communicated from the Arteries to the Veins and Parts, does a great part of it, return back again to the large Veins.

The pressing a Vein below the orifice in Blood-letting.

Moreover, when we open a vein in a bound Arm, if you press that part of the swelling Vein with your Thumb which is neer the orifice, betwixt it and the Hand, or if you make such a ligature as the former betwixt the Hand and the Orifice, you shall see that no blood will come forth; whence it seems to follow, that the blood comes from the Hand, which flows from the orifice. And seeing some pounds of Blood are drawn away by such a Blood-letting, and so much cannot be contained in the lower part of the Veins of the Arm, it must needs come thither from the Arteries, which are not stopped by that Ligature above the orifice, as their Pulse remaining entire doth testifie.

The Ligature of a vein in living Anatomies.

But that we might see the same with our Eyes, we have divers times in great living Dogs, freed the large Vein and Artery in the groyn, from such things as did hinder their sight; which may be easily done if they lie not beneath the Muscles: and we bound the said vein with a thred, and we observed that part of the Vein which looked towards the *Vena cava* to empty and fall in, and the other part towards the Foot exceedingly to swel, so that in regard of its fullness, it seemed harder than the Artery it self; but the ligature being loosed, the Blood presently moved upwards, and the fullness and hardness of the Vein was very much abated. And the Artery being bound, that part thereof did wonderfully swell, which was neareſt *Aorta*, and the other part more remote did fall in through emptiness: nor did the Vein then bound evidently swell. And this we did many times and the effect was still the same.

Dissection of a Vein in living Creatures.

And that we might have no scruple remaining, and might observe withall, what was done within in the Vein, we did lift up the Vein and Artery being thus made bare, and under them we firmly bound the Thigh it self, that the Blood might not move upwards or downwards, by any other Vein save that which we had lift up. Then the Vein being held up, and also shut with a Thred, as is expressed in this Figure, we opened it above and below the Thred with a small orifice. Now immediately from that part of the Vein which was farthest from the Heart, the Blood flew out violently plentifully, and in a full stream, but that part of the Vein which was on the other side of the thred towards the Heart, did only drop out a few drops. whence it seemed to us to be a cleer case, that the Blood did not come downwards from the greater Vessels, but upwards out of the smaller Vessels into the greater. Especially when having made another Ligature upon the same Vein further from the Heart, betwixt the foresaid Orifice and the Foot of the Beast, we saw no blood at all come from that Orifice, whence before it issued with such violence For we conceived those drops which fell from the Orifice neer the Heart, might proceed from Blood which possibly was in the Vein when it was opened, or which it might continually receive from some small Branch of the crural Vein situate above the thred; but this cause will anon appear more evidently.

The emptying of the Veins appearing in the Skin.

It is easie to make this experiment without any opening of a Vein in such persons as have the Veins of their Arms very Conspicuous: In whom if you stop the Vein near the Hand with one Finger, and with your other hand force the blood upwards, and the whole Vein wil appear empty: which wil soon after be filled, when you take away your lower Finger, but not if you take only your upper; as *Harvey* also observed in the 13. Chapter of his Book. For the upper Blood goes into the greater Veins, and the Valve hinders it from descending, which will hardly let any thing pass by, unless the vein be so far widened, that a great space remain between it and the Valves.

Seeing therefore the Blood comes out of the Hands and Feet, and they do not breed new Blood, so as to supply the whole Body therewith, we doubt not but that the Blood in those parts continually and naturally goes into the Veins, *and out of the lesser Veins into the greater.*

TABLE I.

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The Explication of the FIGURE.

- **A.** *The right Leg of the Dog.*
- **B.** *The left Leg of the Dog.*
- **CD.** *The Ligature made under the Vein and Artery, which fast binds the Thigh, expressed in the right Thigh, least the confusion of the lines might disturb the Spectator in the left Thigh.*
- **E.** *The Crural Artery.*
- **F.** *The Crural Vein.*
- **G.** *The String wherewith the Vein is tied and born up.*
- **H.** *The Needle through which the thred goes.*
- **I.** *The upper part of the Vein which flags upon the binding.*
- **K.** *The lower part of the Vein swelling after the Ligature.*
- **L.** *The drops of Blood which fall leisurely from the orifice in the upper part of the Vein.*
- **M.** *The stream of Blood continually spinning out of the lower part of the Vein wounded.*

Nor do I fear that the Arterial Blood cannot be contained in the single coat of a Vein, which I see contained in the smallest little Arteries, and in an Aneurisma, where the Artery hath but one coat. And whereas the Arteries neer the Heart have a double Coat, that might be so contrived, least by violence of the Blood issuing out of the Heart, the Artery might be loosned; as we see it loosened by a strong palpitation of the Heart.

But the Blood doth not come out of the greater Veins into the lesser.

But doth not the Blood flow as out of the Arteries, so out of the greatest Veins into the lesser? This that kind of Blood-letting seems to argue, which is ordained for Revulsion sake: for the Vein of the Arm being opened in a Pleurisie, that Blood seems to be revelled or drawn back, which flowed out of the *Vena cava* into the *Azygos*, and out of the *Azygos* into the *Pleura*. But there is no token that the blood is so revelled; for the Basilica Vein being opened the blood may be drawn out of the Arteries of the Arm; the Arteries of the Arm draw out of the axillary Artery, the Axillaris out of the Aorta, by whose intercostal branches it had flowed into the Thigh, and not by the twigs of *Azygos*, as we shall see by and by. And doubtless, except in the Pleurisie, the blood should be revelled through the Arteries, there were no reason to be given why we should for Revulsions sake rather open the Vein of the side affected, then that on the right side alwaies; since the *Azygos* arises from the right side of the *Vena cava*, and that a Vein to be opened for Derivation is to be opened on that side through which the blood flows into the part affected.

Revulsory Blood-letting doth not argue it.

But what shal we say? Doth not the Arm after a sort grow lean and fall away (and so other parts) when it is bound, as in those who have it hollowed in a Fistula? because the Vein being bound, the blood cannot descend as it ought, unto the lower parts of the Arm? There is no necessity that it should be so. For all that may happen because the Artery is bound. And really, this is an Argument that it is so, in that many times that Arm in which there is an Issue, is perceived to pulse less and more faintly than the other; the influx of the blood and spirits, being in some measure hindred, by the the binding of the Issue. Yet some part may peradventure fall away by binding of a Vein alone; because Nature cannot plentifully infuse new blood through the Artery, seeing it cannot freely go back by the Veins. And though the Veins and Arteries do then contain store of Blood, yet is it peradventure not very fit to nourish the parts as they should be, but this wil better appear hereafter.

Nor the Arms falling away occasioned by a Ligature.

Nor the Varices.

It is nevertheless manifest, that in such as have the *Varices* so called, the blood descends from the *Vena cava* to the greater, and out of the greater into the lesser Veins. For that is easie to see in a Varix of the Thigh and Foot, and in the Hæmorrhoids. But that motion of Blood may happen besides Nature, because the Veins being weakned do not send the Blood upwards, but gather the same; and because the humors by that weight, do resist the Natural motion upwards, and descend, and therefore being collected in great Quantity in the lower Veins, new Blood still coming out of the Arteries; they cause their dilatation and consequently a Varix. Thus artificial Fountains about those places from which they ascend, are most frequently observed to make clefts, being at last drawn asunder and torn by the Heavinesse of the Water, which ought nevertheless according to the Nature of Fountains to ascend upwards. And it is altogether most likely that Varices are caused after this manner: because humors in such as have Varices, do not inlarge the Vein, when they are violently moved in exercise, but when they have rested after exercise; because the humors can resist a smaller motion and descend by their own weight.

But it flows out of the smaller vessels into the Vena cava.

So that these are not tokens, that the Blood goes out of the greater Veins into the lesser, but they argue rather that the Blood goes out of the Arteries into the Veins, and out of the lesser Veins into the greater, and the *Vena cava* it self.

Out of the Vena cava to the Heart again.

We said before that the Blood goes out of the *Vena cava* into the right ventricle of the Heart. But what! Doth that very self same Blood, which *a little before had come out of the* Vena cava *into the Heart*, and out of the Heart was shed into the Arteries, and from thence had returned into the Veins, doth *that* enter again into the Heart? or doth that alone which being newly bred in the Liver doth the first time enter into the *Vena cava*, and hath never yet past th ough the Heart? Truly both.

Yea that Blood which hath already past the Heart.

For that may easily be done, seeing both are alike near to the Heart: and it ought to be done; seeing that which is returned out of the Arteries into the Cava, is more plentifull than that, which is all of it consumed in the nourishment of the *Vena cava*, and that is not carried to the lesser Veins. Doubtless it is a sign that this is so, in that a Vein being tied near the Heart, is not only a little but very much emptied, and sends all the Blood it hath, and not only some to the Heart.

Because the Meat affords not so much Blood as the Heart passeth through.

Also the Heart seems to shed more Blood into the *Arteria aorta*, then the Liver can supply it withall, at least not in some daies fasting. For I have divers times experimented that in many persons the Heart pulses above three thousand times in an hour. And the Heart as long as it hath any vigour left, expels somwhat at every pulsation: for the *Arteria aorta* being bound near the Heart, between the Heart and the Ligature, I opened the said Artery, and I saw some Blood come out at every pulse; till the Heart grew quite to languish, for then somwhat came away after three or four pulses only: because so little was thrust from the Heart, that it could not be moved upwards till some quantity of it was collected, nor pass out at the upper orifice of the Artery.

Also I cut off the tip of an Heart and setting the same upright, I observed though the Ventricles were not full, at every pulse somwhat was shed forth; which also *Harvey* notes in his 2. Chapter. Yea and when the Heart is cut through the middle, there ceased not to come somwhat out, till either the Beast died, or the Blood congealed so in the upper part, as to make a kind of small Skin, so that the Blood could flow no more that way. And certainly somwhat must needs come out of the Heart at every pulse, because there in the Heart is alwaies made more strait, as shall afterward appear.

Viz. about half an ounce at every pulse.

Now, how much comes from the Heart at every pulse, we cannot determine. this I can witness, that out of the Heart of a Rabbit there hath come at every pulse half a dram of blood, and out of the Heart of a great Water-spaniel half an ounce: yet I conceive more comes out, when a live Creature is Dissected, than when it is in health. And if a man would determine by conjecture from what we have seen, how much may come out of the Heart of a Man in health at every pulse, I shall not be against them who say that out of the Heart of a Man at every pulse half an ounce of Blood is shed into the *Arteria aorta*.

Butlet us suppose it is but a scruple; seeing the Heart makes above three thousand pulses in one hour, there must above ten pound of blood pass every hour through

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the Heart, which is more than we eat, and more than the Liver can supply the Heart withall.

So that the Blood moves circularly.

So that must needs be, that the Blood which hath once past the Heart, must flow thither again, and from it return again into the Arteries. So that there is a *circular motion of the Blood*, from the *Vena cava* into the Heart, from the Heart into the Arteries, from the Arteries into the Veins, out of which it returns again into the Heart, and thence into the Arteries.

Which motion of the Blood was not unknown to the Ancients.

Truly, I cannot sufficiently wonder, that in so many Ages past, this motion of the Blood hath been unknown, seeing I find sundry, and those no small intimations thereof in the ancient Writers.

In the Volume of the Works of *Hippocrates*, The Author of the first Book *de Victus ratione*, attributes three circular motions to our Heat and Humors, whereby they are moved inward and outward from divers parts.

To Hippocrates *in* Foëtius *Edition* pag. 344.

Hippocrates in the middle of his Book *de Ossium Natura*, *The Veins* (under which he comprehends the Arteries) *being spred* saith he, *through the Body, do cause a fluxion and motion, sending many branches from one. And this one, whence it hath its original and where it ends I cannot find. For it keeps in a circular course, so that you can find no beginning.* and it will appear plainly to him that examins the place, that he understands this Circle to be chiefly in the distribution of the Humors.

pag. 277.

As also in the End of his Book *de Natura humana*. *The great Veins do mutually afford nourishment one to another the internal to the external, and then again to the internal.*

pag. 229.

And more plainly the Author of the Book *de alimento*. *There is one beginning of all that nourish, and one end of all, and the same is the beginning and the End*: and therefore a little after he subjoyns these words: *The Aliment comes into the Hair and Nails, and from the inner parts into the outer Surface; from the external parts the nourishment comes from the outer surface to the most inward parts: there is one consflux, one conspiration and one consent of all.*

To Diogines Apolloniata.

And *Diogenes Apolloniata* seems not to have differed from this Opinion, in *Aristotle* his 3. *de Historia Animalium* chap. 2. *The most thick Blood is sucke by the fleshy parts, and that which redounds into these places viz.* the greater Veins, *becomes thin, hot, and froathy.*

The FIGURE Explained.

TABLE I.

AAAA. *The Abdomen or Panch of a Dog opened*

BB. *The Midriff.*

CCCC. *The Call turned inside out, towards the Chest, that the inner parts thereof might be more visible.*

DDD. *Three lobes or laps of the Liver turned a little to the right hand.*

EEE. *Certain little portions of the Pancreas which is cut off, that the following Vessels might come into sight.*

F. *The left Kidney covered with its Coat.*

G. *The upper hollow part of the Spleen, together with the adjacent Fat.*

H. *The middle part of the Spleen, about which Vessels are inserted.*

I. *The lowest part of the Spleen.*

KKKK. *The Guts moved downwards, that the following Vessels might be visible.*

LLLL. *The Mesentery.*

MM. *The splenick Artery.*

N. *Part of the Vena splenica annexed to the Trunk of Vena portæ, which falls in, upon the Ligature.*

OOO. *A portion of the Vena splenica and three branches arising therefrom, which are implanted into the spleen, and do very much swell upon the Ligature.*

PP. *The left Mesenterick Artery.*

Q. *A portion of the Vena Mesenterica sinistra, next to the Trunk of Vena portæ, falling in as empty, upon the Ligature.*

R. *The lower part of the Vena Mesenterica sinistra, ready to be divided into branches, swelling by means of the Ligature.*

SSS. *The Mesaraick Veins, therefore more full and swollen, because the Mesenterick Vein is tied.*

TTTT. *The rest of the Mesaraicks, not so swollen, because their Trunk is not tied.*

Yet

To Plato.

Yea and those things which *Plato* in his *Timæus* delivers concerning the Blood, are more suitable to this Opinion than the common.

To Aristotle

Aristotle himself may easily be drawn to this Opinion. For thus saith he in his Book *de Somno* chap. 3. *Every inability of Sense is not sleep, but that only which is caused by the vaporation of Meats, for that which is rarified, must needs after a sort be lifted up, and afterward return and flow back like an Euripus: for the Heat of every Animal, must needs naturally move upwards, and when it is come aloft, it soon after circulates and descends again.*

It is to be feared, that those Writers which followed the former did not sufficiently study the motion of the blood, yea that they obscured the same, because what the former attributed to their Veins, that is to say the Veins and Arteries, these later attributed to the Veins in opposition to, and as distinct from the Arteries. And seeing *Galen* a most excellent Physitian, was not able to reform all things perfectly: and the later Greeks, Arabians, and Latines, have too close followed or transcribed him, hence I suppose it is, that this motion of the blood hath remain'd concealed till this present Age.

But in this Age found out as 'tis by Paulus Servita.

Wherein that incomparable *Paulus Servita* the Venetian, did acurately observe the Fabrick of the Valves in the Veins, which Observation of his that great Anatomist *Fabritius ab Aquapendente* afterwards published, and out of that constitution of the Valves and other Experiments he collected this motion of the Blood, and asserted the same in an excellent Treatise, which I understand is preserved to this very day amongst the Venetians.

The most learned *William Harvey* being taught by the foresaid *Paulus Servita*, did more accurately search into this motion of the Blood, augmented the same with Inventions of his own, proved it strongly, and publish'd it to the World in his own name.

Such hath been the Invention and such the Fate of this motion of the Blood.

Publish'd in Print by William Harvey.

And let us now further enquire, whether *through all the Veins and Arteries* the Blood hath this Motion or whether in some others it hath some other motion? Concerning which thing, that I might be more certainly informed, I contemplated the motion of the Blood in many Veins and Arteries of liveing Creatures, and I have found, besides what hath been already said of the Veins and Arteries of the Arms and Legs, that the blood is moved through the Spermatick Arteries to the Stones; through the Veins from the Stones to the left Emulgent or *Vena cava* in the right side: through the Mesenterick Arteries, to the Guts: through the Veins to the *Ramus mesentericus*: through the Cæliack Arteries to the Spleen; through the *Ramus Splenicus* of *Vena porta* forthwith to the Liver: through the branches of the *Arteria cæliaca*, which answer to the following Veins to the Stomach and Call; through the Gastrick and Epiploick Veins, to the *Ramus Splenicus*: that the short Arterial and Venal Vessels, are branches of the cæliacal Artery and the *Vena Splenica*, which when they are come unto the middle space, betwixt the Stomach and the Spleen, are divided into two branches, one of which goes to the Stomach, the other to the Spleen; by this branch of the Artery the Blood goes to the Spleen, and by the branch of the Stomach to the Stomach; and by the venal branches to the Trunk of *Vas breve*, from the Stomach and the Spleen it is moved through the emulgent Arteries to the *Vena cava*: by the coronal Artery of the Heart into the Vein; out of the coronal vein of the Heart, into the *Vena cava*: by the

Now this motion is made through all the Arteries and Veins of the Body.

Intercostal Arteries into the *Pleura*; out of the *Pleura* by the Veins into the *Azygos*, and thence into *Vena cava*. And this I found by binding the Veins and Arteries in live Anatomies; which did swell in that part which did look towards those parts, from which we have shewed the course of Blood to come, and the other parts did not only grow empty but quite settle and fall in. And I was very careful, not to bind an Artery with a Vein, for then the Artery swelling towards the Heart, would have raised the Vein above it, and so it would have seemed that the Vein was filled on both sides the Ligature.

Yea of the Head.

Now in the *Head* and Neck I saw, and that in a live Goose most easily and in an Hen, that the jugular being tied, did swell from the Head towards the Ligature, and was emptied from the Ligature towards the Cava, so that it is there also manifest, that the Blood returns from the Head through the Veins into the Heart. But if it should come to the jugular veins I cannot determine, since by reason of the hardness of the Skull, I could not accurately dissect the living Brain, but that the Beast would first die: but credible it is nevertheless, that it flows through the carotick and cervical Arteries unto the four Ventricles of the Brain, for they have passages open to the said Ventricles, For those most learned Men *Franciscus Sylvius* and *Franc. Vander Shagen*, have told me, that the fibrous substance being pul'd away which frequently is found congealed in the Veins and Arteries of dead bodies; when it was drawn back in the carotick Artery, it discovered a certain motion, as far as to the third Ventricle of the Brain, and verily, since the blood out of the Ventricles, through the jugular veins, flows back into the Heart, the Ventricles cannot receive it elsewhere, then from the Arteries. But whether the Arteries do shed it immediately into the Ventricles, or into the branches which arise from the Ventricles, is not very easily discerned; because the Arteries, are hardly distinguished from those little branches, seeing the Arteries also have only one Coat in the Brain: but I am apt to beleive, that the Arteries empty their blood, into those little branches of the Ventricles, rather then into the Ventricles themselves; because I have observed those vessels which are inserted into the Ventricles to be greatest near the ventricles, as branches are wont to be at their Original.

Yea in the Child in the Womb.

And thus it is in grown persons; but in the *Child in the Womb*, the Circulation seems to be somewhat otherwise, and thus I conceive it is. The Blood out of the Mothers Womb, does not go into the Umbilical Arteries, which according to the Observation of *Arantius*, are not joyned to the Womb; but it enters into the Umbilical Vein, and from thence into the Liver, the Vena cava, and right Ventricle of the Heart; for the Heart beats in the Child though it be imperfect. Out of the right Ventricle it goes into the Vena arteriosa; but because the Lungs do not breath, and therefore are not opened, they cannot receive the blood plentifully, nor send it to the Arteria venosa; and therefore it goes out of the Vena arteriosa by a peculiar passage into the Aorta, and likewise by a peculiar passage or hole of the Vena cava getting into the Arteria venosa, 'tis poured into the left Eartet of the Heart, and into the left Ventricle thereof. Out of the left Ventricle of the Heart, just as that out of the *Vena Arteriosa*, it enters into the *Arteria Aorta*; so that in the Womb-child Nature useth the two Ventricles for one, least in the Child in the womb, which ought to have much but no intense heat, and which must not be dry, the Blood being twice boyled should be burnt, being destitute of the cooling and Fanning action of the Lungs. Out of the *Arteria Aorta* the Blood goes to the Umbilical Arteries; for they being bound, the part towards the Child, doth pulse and swell: the other part towards the Womb is void of pulsation. Out of the Umbilical Arteries it goes to the Placenta or Womb-cake; where the

Arteries are joyned to the Veins by manifest *Anastomoses*, and by those *Anastomoses* the blood entring into the Vein, is again carried through all the forementioned journey.

It goes out of the Arteries into the Veins.

By Anastomoses.

These are the Vessels by which the blood flows from the Heart. But from the *Vessel* of the *Arteries* it goes into the *Veins* after a double manner; first and most usually by *Anastomoses*, by which the Arteries are joyned to the Veins, which *Anastomoses* are sometimes great and in the greater Vessels as about the Spleen, in the Bladder, in the Womb, in the Womb-liver. And the most accurate *Bauhinus* observes the like Anastomosis of the *Arteria Aorta* into the *Vena cava* of the *Belly*, but I could never yet be so happy as to finde it in the Body of Man or Beast. And therefore they are not all in the extream parts of the Body, but some in the middle parts: and therefore we see in a Cripple whose limbs are cut off, the same motion of the blood continued out of the Arteries into the Veins.

And through the Flesh.

Secondly it seems also possible that Blood may pass out of the Arteries into the Veins, through the flesh it self: for we see when a Vein is opened till the colour change, Inflamations fall, because the Blood shed out of the Vessels, is drawn out of the Flesh. But I conceive the passage of the Blood this way is but seldome and in small quantity.

And that motion of the Blood.

So that it is now, I conceive, clear, *what the motion of the Blood is*, and by what waies it is accomplished: it follows that we enquire, what *kind of motion it is*, and how it is performed.

Is continual.

I have observed that this Motion of the Blood out of the Heart into the Veins, from the Veins into the Heart, is *continual* never ceasing, nor once stopped or interrupted for a moment of time. And the truth is, seeing the said motion is made, as we shall see anon, because the Heart receives and transmits, and seeing this motion lasts perpetually all the life long, the said motion of the blood, cannot but naturally be continuall.

Quick.

Also the motion of the Blood is quick, for an Artery or Vein being bound compressed, it immediately swells and grows round and hard: and when the ligature and compresture are taken away, the blood is seen to be swiftly moved.

So that the whole Circuit or round is performed in less than a quarter of an hour.

But how soon the blood performs its Circuit from the Heart and to the Heart again, I cannot precisely determine. We observe it is done sooner by an Anastomosis near the Heart, than by one off; nor will I be much against him that shall say the greatest Circuit from the remotest parts of the body is performed in less than a quarter of an hour; for the blood passeth with exceeding celerity. Howbeit it goeth not so swiftly, as we see it leap out when a vein or Artery is opened, because then it is moved in the free and open Air; but within the body it is compressed to lift up its vessels, and to thrust on the foregoing blood.

And therefore we see an Artery being cut open especially if near the heart, is sooner emptied than the heart can supply it with new blood.

Nor do the Fits of Agues argue any other.

But if this be true, why do Feavers return once in a quarter of an hour, seeing the Fit seems then to happen, when the corrupt matter comes to the heart? whereas now some fits come every day, others every third, and some every fourth day. Truly, I will not deny, that it may fall out, that when the Corrupt matter comes to the heart, the Fit may happen, as *Harvey* hath an example thereof, in the 16. chapter of his Book. But I do not think it is necessary, for some portion may slip out of the corrupt Seminary, or some sooty stream may arise, and go into the heart and so raise the Feaver, as most Feavers are seen to arise from the Inflammation of the Parts, which the Imposthume being opened and the Quitter removed, do cease. And as such kinde of symptomatick Feavers, even so also may some intermitting Feavers and Agues happen, by reason of some matter shut up, within or without the Vessels, which by putrifying every day, every third day, or every fourth day, regurgitating or fuming into the large Vessels, may bring the Fit.

Nor the Exacerbations of Feavers.

In continual Feavers I confess, whose matter is to stick to the larger vessels, it is harder to shew a reason why there should not be a Fit or Exacerbation at every Circuit of the blood. But I conceive I may alledg the same cause which is vulgarly given, why continual Feavers are not allwaies alike feirce; because, though the matter be sufficiently near the Heart, yet it doth not cause a Paroxism till it have attained a certain degree of putrifaction: and that the Fit lasts so long, till that putrid matter be evacuated, which touches the Heart, or sends its Fumes thereto. But I suppose no man, because of the reason of the return of Ague-fits, which is altogether abstruse and unknown, will deny the motion of the blood to be very quick, which is a very manifest thing.

This motion is also vehement.

Besides swiftness, the blood *hath vehemence* in its motion, which appears from what we have said touching the Hardnesse and Tension or stretching, which the Veins and Arteries acquire when they are bound: for nothing can be distended by a liquid Substance into an extream hardness especially upwards, unless it be vehemently driven thereinto or retained therein. But this vehemence,

Not of like vehemence in the Arteries and Veins.

of motion is chiefly near the Heart, removed from which it grows by degrees lesser and lesser, so that the little Arteries in the remote parts, do not pulse, unless some impulse of blood greater than ordinary do happen, as we observe to happen in Feavers, therefore it is that the Veins are not seen to pulse, because the impulse of the Blood is less in them than it is in the smallest Arteries; and because the Veins joyned to the Arteries by Anastomosis, when they go from them, divide themselves into more little branches and twigs than the Arteries do; for when Rivers are divided into divers Arms the force of the waters motion is abated. And therefore when some Arms of a Vein are shut, either by something pressing them, as in certain Tumors, or somewhat which stops them, as in the Varices, the blood slipping back by its own weight, the force of the bloods motion is then again observed, and the Veins are seen to pulse: for I have often observed in the Veins which are transparent through the Skin, that most of those palpitations in the parts, which are thought to proceed from Winds, are nothing else but the pulsations of the veins.

Yet the same Quickness in both.

And because the motion is more vehement in the Arteries than in the Veins, it seems at first sight to be swifter also *in the Arteries than in the Veins* just as Men, Horses, and other Animals which move themselves with great labour, and through mistake judged many times to make the greater speed. For the Blood forced through the Arteries cannot all pass through the Anastomoses, because it comes out of a wide place into a narrow, and therefore it is accumulated in the Arteries, they are dilated, in which dilation they persist a small time, wherefore in the middle of the dilation and in the whole time of the rest, that same force doth very little further the quickness of the bloods motion, which motion is in the mean e me

more

more free in the veins, becauſe it comes out of a ſtrait into a wide place, and is performed by more wayes. Now Reaſon doth teach us in this Caſe, that in this motion of blood, the ſwiftneſs hereof muſt be alike in the Arteries and the Veins; for as much blood as the Liver ſends to the heart made of new Chyle, and as much nouriſhment as the Arteries give to the parts, muſt be repayed, or the Heart will at laſt be void of all moiſture, which thing alſo ſenſe confirms, for the *Vena cava* pulſes ſo often, in that whole Tract from the Liver to the Jugulum, and therefore drives into the heart, as the Artery is obſerved to pulſe and therefore to receive from the heart. But we ſhall hereof ſpeak more anon.

Yet of greater quickneſs when the Heart beats.

Howbeit in the Arteries themſelves, the blood is moved more *nimbly* when the *Heart drives it*; from which Quickneſs it departs by little and little, when the Heart begins to reſt and is afterwards dilated. Yea and in the Veins themſelves, the motion of blood is more vehement and quick when the Heart pulſes; which as we have obſerved in live Anatomies, ſo have we often noted the ſame, when a Vein hath been opened in the Arm, in which the Veins were not much diſtended with the Ligature. Alſo the foreſaid palpitations of the Veins, ſeem to proceed from no other cauſe then that the Veins being ſtraitned by the Blood ſliding back, or by ſome other means; when the blood cannot by its force make it ſelf way, it lifts the Vein up, which falls again, when that forcible endeavour is abated or the Vein gives a freer paſſage to the Blood flowing through the ſame.

One portion of blood doth not allwayes go the ſame way.

But I do not conceive that the blood which is once carried, for examples ſake to crural Veins, is continually carried the ſame wayes, but that when it is returned to the Heart, it is mixt with *that blood which comes out of other parts*; and is ſo promiſcuouſly diſtributed to the parts of the Body: for ſo the parts may be the better nouriſhed, if they have alwayes new blood, out of which they may draw, that which may beſt ſerve to nouriſh and ſtrengthen them: ſo Plants do beſt grow, when they are tranſplanted into new Soils.

The Vital Spirits are moved with the Blood.

This is the whole Manner of the Bloods motion: and alſo of the *motion of the Vital Spirits*, ſeeing they are mingled with the Blood.

The Animal Spirits motion through the Nerves cannot be obſerved.

I have often endeavoured to ſearch out the *motion of the Animal Spirits*, but I could not elſewhere obſerve it ſave in the Muſcles, which ſeemed to them to be diſtended broadwayes and deepwayes, and being cut aſunder to tremble and pant. For the Nerves being bound neither ſwell nor are they extended, and being cut in ſunder they ſhew no other motion, ſave that they contract themſelves. And it is a very eaſie matter to bind the Nerves of the ſixt pare, which freely wander through the Cheſt.

But the motion of the Chylus eaſily through the milkie Veins.

What kind of motion that is.

But the motion of the Chyle through the milkie Veins, is moſt manifeſt. Now it is not ſo continual as that of the Blood, becauſe there is not alwayes a ſupply of Chylus. And when it wanders out of the Guts through the milkie Veins, it goes quicker than the Blood it ſelf, and the Veins being bound do ſwell immediately. And therefore they do not long appear in live Anatomies, nor are they found in dead Carcaſſes; unleſs ſome obſtacle do hinder the motion of the Chyle. And in that being bound they do not ſo ſwell as to grow hard, it ſeems to be a Sign that the motion of the Chyle, is not ſo vehement as that of the Blood: peradventure becauſe the Chyle is to be moved through a ſmaller ſpace, the like violence of motion was not requiſite.

The Cauſe of the Bloods motion.

But it is now time to enquire into the *Cauſes* of *theſe motions*, and firſt of the motion of the Blood.

Whatever the Cauſe is, either it muſt be moved by an inbred vertue or faculty, or by ſome motion which muſt be referred to carrying, drawing, or thruſting.

Is not an inbred power thereof.

That the Blood is moved in this manner by its own proper Vertue, we cannot obſerve, either from the Blood received in a Baſin or ſhed into the body, which that it ſhould be in a moment corrupted is hard to ſay: nor can we ſee ſuch a ſpontaneous motion in any inanimate thing. And whereas *Harvey* relates Chap. 4. that when the Earlet was ſtill, he obſerved the motion of the Blood; I likewiſe have obſerved the ſame, and likewiſe when the Heart was quiet; but withall, that motion was imparted to the Blood from the *Vena cava*, and that in the Heart from the Earlet, as we ſhall ſee anon.

Nor is the blood carried by the Spirits.

That the Blood is here carried by the Spirits cannot by any Argument be proved: and they by their lightneſs ſhould move the Blood upwards, which we ſee here to be moved downwards and ſidewayes.

And therefore it remains that either the blood muſt be drawn or thruſt.

Nor is it voided by reaſon of rarefaction only.

That the blood is thruſt forwards, Men of excellent wits do conceive, becauſe the Hearts heat immeaſurably rarifying the ſame, it requires a greater place, and that therefore it dilates and lifts up the Heart; and ſeeing it cannot be contained in the dilated Heart, it is poured with ſuch violence into the *Vena Arterioſa*, and the *Arteria Aorta*, that it diſtends all the Arteries and makes them pulſe. And they bring this Argument for their Opinion, that the Heart of an Eel or any other Animal when it leaves pulſing, if it be warmed by Fire held under it, it is ſeen to pulſe again. But whether may not that pulſe happen, becauſe the Spirit being by that heat made more luſty, can better aſſiſt that cauſe which moves the pulſe in the Heart; juſt as, when the Guts and Muſcles are heated in a live Diſſection, in which nevertheleſs there is no ebullition, the motion ſeems to be reſtored. For there is indeed only a certain light Rarifaction proceeding from a certain warmth in the Heart; no ebullition or ſudden diffuſion. And truly I have often ſeen in ſtrong Dogs, that the Blood doth not leap out of the Heart by reaſon of Rarifaction; whoſe Heart the tip being cut off; when through the Efflux of blood it was not half filled, being ſet upright, it was not filled by rarifaction: but the Conſtriction following, that portion of blood which was left in the Heart, was ſpirted out above four Foots diſtance, ſo that my ſelf and others by me (for many were preſent) were beſpattered therewith, whence it is manifeſt, that the blood is driven by the part.

It is alſo driven becauſe the blood being ſo changed, is troubleſome to the Heart and thoſe parts. For if the whole Heart, or the tip thereof living and Diſſected, or other greater particle, be pricked with a Pen-knife or a Pin; as often as it is pricked, ſo often it will move it ſelf as by Natural motion, though it ſeem long ago to have loſt all motion.

But it is driven by the Vena cava into the Earlet.

And that the Blood is driven by the *Vena cava* into *the right Earlet of the Heart*, I have manifeſtly ſeen in the diſſection of live Creatures: for in all motions of the Heart, the firſt beginning of Motion is ſo or no, becauſe the Cava was knit to the Earlet and the Heart, we cut the Heart and the Earlet quite off in living Dogs, at the *Vena cava*, and we obſerved, that even then the

the *Vena cava* did a very little pulse, and at every time did send forth a little Blood. And therefore the *Vena cava* hath certain fleshy fibres, for the most part, about the Heart, which elsewhere you shall not find in the *Vena cava*: but they may be seen very evidently in the *Vena cava* of a Man, an Ox, a Dog. Now the motion of the *Vena cava* is most evident neer the Heart, yet for the most part I have observed it also in live Dogs, all along that passage from the Liver and from the Jugulum, as far as to the Heart.

Out of it into the Heart.

The *right Earlet* drives that Blood which it receives, by a certain tension and constriction into the *right Ventricle of the Heart*: for also in the Earlet the motion or constriction is a little sooner than it is in the Heart. And the right Ventricle of the Heart being cut open as far as to the Earlet, at every constriction there manifestly appeared somwhat to be droven out of the Earlet into the Heart, which also *Harvey* observes in his fourth Chapter.

Yet is it drawn also?

So that the Blood comes chiefly by pulsion, into the right Ventricle of the Heart. But is it not also *drawn* both into the Earlet, and the right Ventricle? I conceive so: for with part of that Blood which they receive, they ought to be nourished within: now that which must nourish, must be drawn, to the end the part may receive that Blood which is most useful to it; for by pulsion also that which is unprofitable is sent away, as *Galen* excellently (according to his wonted manner in other Cases) doth infer in his 1, 2, and 3. Books *de Nat. fac.* Now this drawing is not only of that blood which is near, but also of that which is far off, as all parts have that faculty, least they should be soon destitute of nourishment.

But doth not the Heart also draw, because it is widened, to avoid Vacuum, as we are wont to say? It is not likely, because in its dilatation there can be no fear of Vacuum, as shall hereafter more evidently appear.

The cause of the motion into the left Ventricle, is the same.

As the Blood comes to the right *Ventricle of the Heart*, so also it comes *to the left*, save that we could not observe the impulse of the Blood, when the Lungs fall, to be so strong out of the *Arteria Venosa* into the left Earlet, as out of the *Vena cava*; yet there is manifestly some.

And happens in both places at one moment.

But the Impulse into both Earlets and into both the Ventricles, happens at one and the same moment of time: save in Creatures ready to dye, in which we have observed, that both Earlets and both Ventricles do not pulse at one and the same time.

But when the Blood is thus driven into the Ventricles of the Heart, the Heart hath no motion evident to the Eye, but putting our Finger upon the Heart, we perceive somewhat to enter into the Heart, and that the Heart becomes fuller; which also *Harvey* hath observed, in his 4. Chapter. Yea, we have observed that the Earlet hath pulsed seventy, sometimes an hundred pulses, before any motion of the Heart followed.

So that we see how the Blood is moved into the Heart. Let us now see how it is moved into the Arteries.

The Blood is driven out of the Heart into the Arteries when the Heart is contracted.

The *Blood is moved into the Arteries by way of pulsion or driving*: for an hole being made in the Heart, we saw Blood come forth, when the Heart contracted it self; also the *Aorta* or *Vena Arteriosa* being cut off from the Heart, we saw Blood poured forth when the Heart did straiten it self; the tip of the Heart being cut off and the Heart set upright, we saw the Blood expelled and leaping out of the Heart; the Heart being cut a thwart in the middle, we saw the Blood expelled in the Systole, but we never saw it go out in the Diastole. And whereas some say they have seen in live Dissections the Blood come out in the Diastole, I conceive they were deceived, by taking that to be a Diastole, which is indeed the Systole, which also that rare Anatomist *Columbus* observed in his 14. Book *de Re Anatomica*.

For in the *motion of the Heart*, we must exactly distinguish betwixt the Constriction, Quiet, and Dilatation thereof.

The Cause of the Constriction of the Heart.

In the *Constriction* or Systole of the Heart, the point of the Heart draws neat to the Basis, and therefore it becomes a little broader. And in his Animals in which the Aorta is inserted not into the Basis of the Heart, but a little towards the middle, as in Rabbits, Eels and such like, the Basis also of the Heart draws towards the point. Now the sides of the Heart, seated against the right and left Ribs, do come one nearer to another, so that if you shall cut off the tip of either side, so that it may hang, in the constriction it will return unto the sound side and as it were into its place. But the side of the Heart against the Breast-bone, is lifted up, and especially towards the Basis: and so the whole Heart is bent and stretched on all sides, and that part near the Basis being lift up, seems most of all to smite the breast, and to make that beating which we feel; although the point also may do it, which that great Anatomist *Riolanus* observed, in the sixth Book of his *Anthropologia* Chapter, 12.

And that I might be the better assured, that this motion of the Heart now described, is the Constriction thereof. I have sometimes cut off the tip of the Heart, and sometimes cut it asunder athwart through the middle; And I manifestly saw, when it made the foresaid motion, that the Cavity of the Ventricles became less, and my Finger being put into the hole, I felt the Ventricles contract themselves to my Finger. And the self same motion which I have shewed in the Heart makes externally when it contracts it self, it shews also inwardly; save that there seems to be no motion in the *Septum intermedium*: peradventure, least the Septum to straiten the left Ventricle, should come nearer the left side of the Heart, it should leave the right Ventricle wider.

Which is performed by help of the fibres.

This is the Tension and Constriction of the Heart, whereby the Blood is forced out of the Ventricles of the Heart, into the *Vena Arteriosa* and the *Aorta*. And when it is languishing, it is made only by the help of those fibres wherewith the flesh of the Heart is furnished; but to make a stronger constriction, those greater fibres concur, which are seen in the Ventricles of the Heart, as I have often observed, in Dissecting the Ventricles of the Heart in live Anatomies.

Now those fibres in the Ventricles and in the substance of the Heart it self, do manifestly cause the Constriction, because they are on all sides distended broadwise, and therefore they are abbreviated as to length; just as all the musculous parts of our Body, do in like manner perform their motion: and therefore when we would chew our meat we feel our temporal Muscle swell and grow hard. By reason of this swelling the Cavity of the Ventricles of the Heart, is made more strait. And this Tumor of the Flesh and greater fibres begins at the Basis, and proceeds gradually unto the tip. In regard of which Motion if *Hypocrates* in the Beginning of his Book *de Corde*, cal'd the Heart a strong Muscle, he did truly after an elegant manner expres the manner of its Motion.

The Heart after its Constriction returns to its Natural state.

When the Heart by its Constriction hath forced the Blood into the Arteries, it returns to its Natural state. For the point returns from the Basis, as also the Basis from the point, in those Animals which have no passage into the *Aorta*, in their basis; but the left and right side of the Heart, extends it self towards the Ribs, and that side which looks towards the Breast-bone falls in, especially

there

there where it answers to the Orifice of the Aorta, and then the whol Heart *rests* and is found loose and soft.

And unless that upper side did settle and fall in, the Heart would be dilated in this return hereof to its naturall state, as is easie to see and feel, when the heart is dissected. But that upper side must needs fall in, least the heart being emptied by foregoing constriction should admit a Vaccuum. But when out of Vena Cava and the Arteria Venosa, new blood is forced into the heart, and the Blood contained therein is rarified by heat, then the upper side rises: and the other sides, as we said before, remain extended. And so the heart is then in its *dilatation*; nor is there any other dilatation of the heart save this, to be observed.

And then it is dilated.

In the Particles of a live heart dissected and taken out of the Bodie, there is no other dilatation then a remission or slackening from Constriction. Indeed in those particles where constriction is ceased, there remains a seeing kind of Palpitation; but that is another kind of motion proceeding from the spirit conteined in the flesh and seeking its way out; such as may also frequently be seen in the muscles whole or dissected, in Creatures dissected presently upon their death.

So that the Dilatation and Constriction of the heart happens after the same manner as that of other parts, the Stomach, Gutts, Bladder, Womb, which are distended by what is sent into them, which when they have voided, they return to their naturall state.

Now we cannot better observe this motion of the Heart, then in those Beasts which have only one ventricle in their Hearts, or if they have two, when the Animals begin to languish, otherwise when the Creatures are strong, the motion is hardly discerned because of its Swiftness; also because the two ventricles present those motions doubled; and because the Cone of the right ventricle, seeing it is less high then the left, when it is drawn back to the Basis, it makes an oblique motion.

The Blood is driven out of the greater into the lesser Arteries.

But let us return to our business, and let us see further how the blood out of *the Arteries near the Heart*, is spread through the Arteries of the whol Body, now it is done by a manifest Impulse or driveing or any Artery being bound, at the Ligature it swels very much, and is stretched to an extream hardness.

Notwithstanding the *Heavines* of the Blood furthers its motion downwards, and therefore the Heart seems to have been placed neerer the Head then the Heels.

Yet it is drawn withall.

It is also likely that the Blood is drawn into all the Arteries, to the end that they and their neighbouring parts may be nourished with convenient Blood.

Not necessarily by dilatation of the Artery.

But that the Arteries should draw by being widened, there seems no necessity: for the Blood may be driven forward only by impulse, and the Arteries may drive the same: for an Artery being broke and an Aneurisma made in the Flesh, the Aneurisma in the flesh, is perceived to pulse after the same manner as the Artery; wherein manifestly the flesh doth not draw the blood by dilatation, but the blood is driven into the same. A miserable example whereof we lately saw in the most expert Dr. *Johannes Elemannus*, in whom an Artery breaking, the Aneurisma possessed a fourth part of his Chest. And the like was observed by *Riolanus* in the 6. Book of his *Anthropologia* chap. 12. And that indeed the pulse of the arteries is caused by the Impulse of Blood, the waving, creeping, pismire pulses seem to shew, and many others which manifestly imitate the motion of the Blood in the artery.

Nor doth Galens *experiment shew any other thing.*

True it is indeed, in that Book of *Galen whether blood be contained in the Arteries*, in the last words it is asserted, that an hollow Reed being thrust into the arteries, and the artery tied above the Reed, the artery doth not pulse beyond the ligature, though the blood may be driven through the Reed. But I suspect that place is mained and wants somwhat, because after the manner there described, the operation can very rarely and hardly succeed. for a free artery is there prescribed to be opened out of which when it is open, every body knows what a world of blood leaps out, so that either the Creature will die, or through its weakness, no arteries at least not those more remote can pulse.

But suppose the place is perfect, and that the operation shall succeed as it is there described, it may happen that the Creature quite languishing because of the flux of Blood, the pulse might be felt on this side the Reed, because the Reed being thrust in, rendring the artery more narrow, might in part stop the blood, so that it might easily fill the artery and list it up. So I have many times seen, arteries which shewed either a languishing or no pulse, manifestly pulsing, when they were compressed not very far from the Heart. But *Galen* observed no pulse beyond the Reed, because through the Reed much narrower than the artery, the artery received little blood. And that such a thing might easily happen, I have observed in a Rabbit, into the *Aorta* whereof, it being tied on each side we thrust a little Reed, but because the ligature being loosed the Beast died, we thought it not worth the while to bind the artery above the Reed and we thought we saw some pulse as far as to the Reed, but we could perceive none beyond the Reed.

Moreover we could never make that experiment succeed, because it is not easie to find a convenient Artery, and when it is found and duly opened, the Creature most speedily dies, either because of Bloodshed, or (which may seem strange) by Convulsions.

So that we can see no other, but that the Blood being forced may pass through the Arteries, and that by it also the Arteries may be distended. nor seems it necessary to call any other Cause to make the Arteries pulse, seeing the forealleadged Cause may suffice. Yet Nature is wont frequently to call more assistances to the performance of her works then do indeed to us seem necessary, who cannot alwaies dive into her Secrets. So here, some tokens are observed by *Galen*, that besides that dilatation they receive from the impulse of the Blood, the Arteries do also endeavor their own dilatation. That all the Arteries of the body both in sound persons and Creatures, and in live Anatomies, do pulse in one and the same moment: but nothing that is moved to distance, can be every where at one moment; and therefore not at the same moment make distention every where. The Guts when blown up by Anatomists, or Pudding-makers, are seen to be distended in the parts neer the Blower first, before the remoter parts are distended. True indeed it is, that the Arteries are not empty as the Guts, but they are distended being partly filled with blood: yet, seeing that blood which comes out of the Heart must thrust forward that which is next it, and *that* again that which is next it, and so forward untill the Arteries be filled and distended every where, it doth not seem, though the motion be performed out of a wide into a narrow place, that it can be performed in one moment. just as we see twenty stones which the Boys set in a row, the greatest first; when the first is beaten down, all the rest do not fall in one moment. And therefore we may suspect, that the Diastole of the Arteries, is caused by the impulse of blood, and by their own proper dilatation: and that both these causes contribute to the bloods motion.

Yet Galen *hath certain tokens that the dilatation of the Arteries helps their motion.*

De usu puls. *cap.* 5. An sanguis in Art. *c.* 8.

Hence also it appears, that this same impulse of the Blood is made only by the

But the impulse is here caused only by the Hart.

the Heart, nor does one part of the Arteries drive it into another: for that part which drives by constriction, that cannot in the same moment be dilated, but all the Arteries are dilated in a moment.

Out of the Arteries into the Veins, out of the smaller Veins into the greater

And thus the blood is moved through the Arteries; and out of the *Arteries* into the *Veins*, out of the lesser Veins into the greater and the *Vena cava* it self, the blood is moved also by *Impulse*. For any Vein being bound in living Creatures, it falls in, and growes lank towards the Heart, and it is filled in that part which is more remote from the Heart,

It is driven.

And this same Pulsion to the Heart, seems to happen from any part of a Vein, for a Vein bound or compressed in a living Arm it is not only stretched in the part remoter from the Heart, but also in the rest thereof nearer the Heart it falls in and is emptied; which nearer part if you also tie that also will be distended beyond the Ligature, and will swell. Now this Pulsion is caused by the Fibres whereof the Veins are constituted.

By every Particle of the Vein.

And drawn.

We conceive nevertheless that the veins do also draw, least they should receive the blood without choice, and that they may draw to themselves that which is most useful: howbeit they seem to receive the blood more by Pulsion then by traction or drawing, because the veins being bound, are wonderfully distended.

In the *Vena cava* there is a certain Store-house of Blood, wherein blood is treasured up for future Uses, when it is more plentiful then that all of it need be sent unto the Heart.

So also by Pulsion the Chyle is moved out of the Stomach.

And all these are Causes of the Natural motion of the blood. To which the *causes of the motion of the Chyle*, are not unlike: for the *Stomach* contracting it self by its Fibres, *squeezes* out as much Chyle as is digested, And by that pressure it seems also to open the Pylorus: for there seems not to be any spontaneous motion in the Pylorus, such as is in the Stomach or the Guts.

Through the Guts.

The Chyle staies not long in the *Guts*, but is presently driven out *by the constriction of the transverse Fibres*: and while many fibres, and which mutually follow one another, do act, the Chyle is pressed, nor can it all slip downwards, whereupon some of the pressed chyle slips into the milkie Veins; yet least that the Chylus should slip too soon to the Fundament, it is stopped by the constriction of the lower transverse Fibre: and being thus shut, and compressed above and beneath, it is pressed through the wrinkled Coat of the Gut, as it were through a strainer into the milkie Veins. Now this same constriction of the transverse Fibres, happens in all the thin or small Guts, and in all the thick or round Guts, in a certain order, and at certain distances of time.

By the milkie Veins.

That the Chyle is moved through the *milkie Veins* into the Veins of the Portæ, into the Liver, and sometimes also into the *Vena cava* by pulse, a Ligature does shew.

And also drawn.

It is also likely that Chyle *is drawn* out of the Guts and milkie Veins, for it is moved more swiftly out of them, then the Guts or *Venæ lacteæ* do seem to drive or force the same.

The Chylus in the *Ramus mesentericus*, *Vena portæ* and *Vena cava*, being mingled with the blood, is moved by the same cause, which there as we have said, does move the blood.

Why not through the mesaraick Veins.

Now the Chylus is carried by peculiar Veins, rather then by the Mesaraicks which contain blood, because the Mesaraicks being to admit blood, were to have their mouths opened into the Guts, through which the blood would easily have slipt into the Guts. Nor could the drawing Faculty prevent that inconveniency, which is here much obscurer and much weaker then the expulsive Faculty.

As this Motion of the Chylus, so also the circular motion of the blood hath its uses and conveniences, of which the principal seem to be these.

The motion of the blood serves for the utility of the parts.

That by the continual passage thereof through the Heart, the blood is also continually heated, and whiles som blood goes through seldomer, other blood oftner, there is found in the Veins blood of all Qualities: which while it is carryed into all parts, and Nature unlocks, and offers all the treasure to them, they may be the better heated, and receive that Nourishment, which may be most convenient to feed and strengthen them.

And that it may be preserved.

But this motion does also contribute much to the preservation of the blood in its integrity, free from corruption or putrefaction: for

Vitium capiunt, ni moveantur aquæ.
Unstirred waters easily corrupt.

which is also most true of the blood, as we may daily see when the Vessels are obstructed.

And to perfect the Blood.

It contributes also to the perfection of the Blood, whilest by continual motion, it is rarified and attenuated. But it makes chiefly towards it perfection, in that the blood is sometimes attenuated, grows hot, and is rarified in the Heart, and sometimes again it is condensed and congeales as it were in the Habit of the Body. For no part in the Body is hotter then the Heart, and none less hot then the Habit of the Body. And therefore there happens a certain Circulation as it were, not unlike to that whereby the Chymists make their Spirits most subtile and perfect. For the blood which is attenuated by heat, after it is condensed by cold, is able to persist in that thinness, nor does it return to its old thickness: from which degree of thinness in tract of time it attains to a greater by means of heat, in which being again condensed by cold, it comes to continue; and so at last it becomes most fit for the making of vital Spirits.

The blood which is carried to nourish the part, is not moved circularly.

For this end the blood is moved circularly; but hath it not therefore elsewhere another motion? Out of the smallest Arteries the blood is carried right out into the flesh, that it may constitute the nameless humor, the *Ros*, *Gluten*, and *Cambium*, nor does it return hither from whence it came, least the blood flowing through the least, should hinder these humors from being gleued and assimilated to the parts.

It flows also sometimes chiefly, because it is driven out of the Arteries into the flesh: and frequently also the chief moving cause is attraction: for the bones cannot without attraction receive the thicker part of the humor for their nourishment, and leave the remaining thinner part thereof, unfit to nourish them in the Vessels.

Some

The FIGURE Explained.

AAAA. *The vulgar meſaraick Vein and Arteries, derived from the Gate-vein called* Porta.

BBBB. *The milkie Veins diſcovered by* Aſellius.

C. *The Glandule or Kernel in the Centre of the Meſentery which* Aſellius *calls the Pancreas or Sweetbread, to which all the Branches of the milkie Veins do go.*

DD. *Two milkie Branches greater then the reſt, aſcending by the Porta, and inſerted into the Liver by the Opinion of* Aſellius.

EE. *The Lobes of the Liver.*

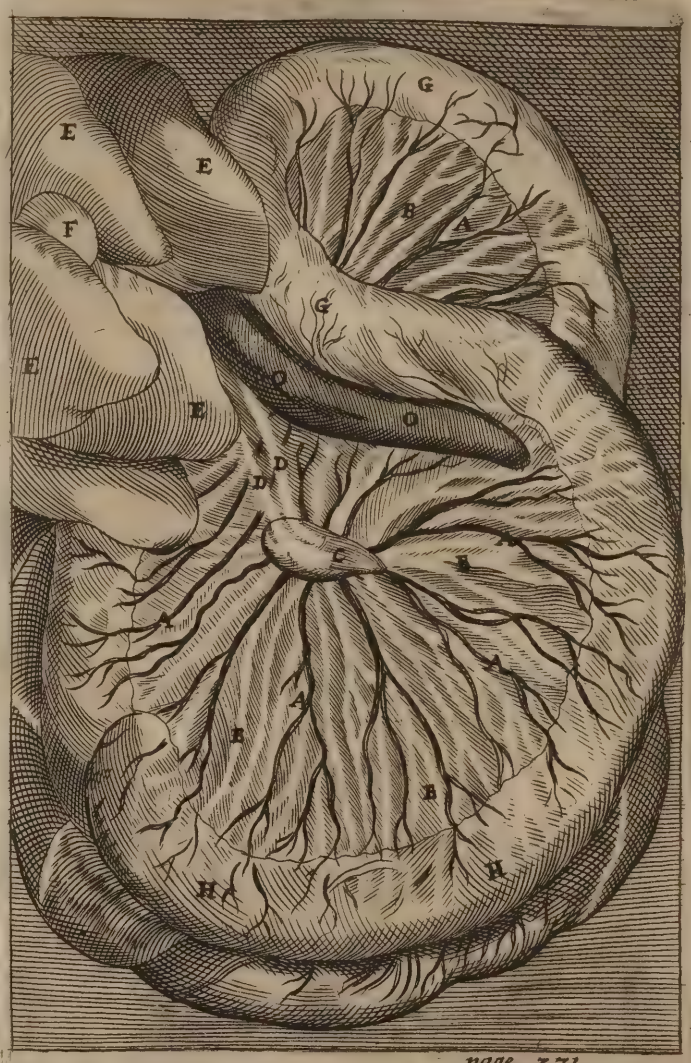
F. *The Gall.*

GG. *The empty Gut called* Jejunum.

HH. *The Ilium.*

OO. *Glandulous Fleſh in Dogs, by the Duodenum and the Entrance of the Jejunum, which may be called in Dogs, the lower part of the Pancreas.*

TABLE. III.



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Nor is there any other motion of the Blood, whereby the Valves of the Heart are ſhut.

Some alſo there are who ſuppoſe, that the blood being carried out of the Heart does go back, and return again by the Arteries into the Heart. Which they are therefore moved to think, that they may be able to give a mechanick cauſe, why the Valves of the Heart in the Orifice of the Arteries, do fall down and are cloſed up. I truly have alwaies eſteem *that* a rare deſign of *Eraſiſtratus*, to explain all things that happen in our Body mechanically, but I account it a raſh thing in him to meaſure the Wiſdom of God by his own Wiſdom. And theſe are to be counted Engins, which evident reaſon, and eſpecially Senſe do ſhew to be ſuch. Here contrariwiſe our Senſes obſerve, that the blood goes through the Arteries from the Heart not to the Heart; and in a rare and languiſhing Pulſe, that the Artery does not ſwell laſt, where it is knit to the Heart, as it ſhould do if that Opinion were true, but firſt of all. Alſo that the Valves are not ſhut by the blood running back, we have this ſign, that in caſe the Artery be bound two fingers from the Heart, and it be ſo opened betwixt the Ligature and the Valves, that the blood may freely paſs forth, and therefore go neither backwards nor forwards; yet the Valves may be divers times well faſtned, the Heart ordinarily moved, and ſo as not to ſhed forth the blood, ſave in its conſtriction. And therefore if I would here allow of any mechanical Motion, I ſhould admit the common Opinion, which ſaies, that the ſhutting, as of the heart, ſo of the Valves, is performed by contraction of the Fibres. For that ſame contraction of the fibres in the Heart, is every where obvious to the Eye-ſight.

Nor in Paſſions of the Mind.

But we have truly no ſign or token that the Blood is any other waies directly moved through the Veins from the Heart, or through the Arteries to the Heart. In Joy, truly, the Humors move outwards; but this may be betide by the Arteries alone. And in Sadneſs, the Humors may be moved inwardly through the Veins alone: and they muſt needs do ſo, for ſeeing the Pulſe does not ceaſe in Sadneſs, and by the Pulſe there goes continually ſomwhat through the Arteries outwards, hardly can any thing be moved through the Arteries inwards, and to the Heart.

Yet there is another præternatural motion thereof.

Howbeit, præternaturally the humors have another motion beſides that which we have here deſcribed, whileſt by their lightneſs or other activity, they mount upwards, or by their weight deſcend downwards, as is manifeſt in ſuch as have the *Varices* ſo called. Alſo that way being ſhut up, by which they were wont to be moved, they are compelled to ſeek another. So in a Duck I have divers times ſeen in the Veſſels of the Breaſt, the blood parti-coloured, ſome whiteiſh, ſome reddiſh, which the Artery being contracted, was moved to and from the Heart, in divers ſides of the Arte-

ry;

ry: but that motion lasted not long, nor did the blood ever enter into the Heart by that motion.

And thus (most worthy Friend *Bartholine*) I conceive I have answered your Question touching the motion of the Blood. Whereinto I did enquire more scrupulously, that I might better know the Nature of the Humors, and their Deflux: from which Flux of Humors innumerable Diseases arise. I did also believe that I might more exactly understand how good or bad blood was generated, if I knew those Parts by which the Humor passing along might be changed. Also I conceived that I should be better able to judg, how very many Diseases ought to be cured, if I knew which Vein being opened, would evacuate such and such parts, and through what parts the Remedy ought to pass, before it can come to the part affected? Also innumerable things came into my mind, diffused through our whole Art, as the Doctrine of Pulses, of Feavers, of Inflammations, their Generation and Cure, and other things, which made me desire to be acquainted with this Motion of Blood.

And the Experiments whereby I was brought into this Opinion, are so evident, that I doubt not to affirm, that learned and discreet Physitians will henceforwards, allow of this Motion of the Chyle and Blood. Howbeit in some Causes and in certain circumstances of this Motion, I cannot promise the like Agreement: for sundry men are Naturally inclined by a disparity of their Judgments, to embrace different Opinions.

Touching the truth of these Experiments, you cannot (my *Bartholine*) make Question, who have your self seen many of them: and there were frequently present most learned Doctors of Physick not unknown to you, *Franciscus Sylvius*, *Johannes Van Horn*, *Ahasuerus Schmitnerus* most accurate Dissecters; and those persons of solid Learning *Franciscus vander Schagen*, and *Antonius Vockestaert*: nor were they only present, but they also afforded their Counsels and Handiwork to help make the said Experiments: to whom in that respect I am very much obliged. And so farewel most learned *Bartholine*, and persist to love me. Dated at *Leyden* the 10. of the Kalends of *October*, *Anno* 1640.

THE SECOND LETTER OF THE Motion of the Blood, To the said BARTHOLINUS.

SUch is the Fate of Writers, that they are compelled to write when they are unwilling: that so they may answer their Adversaries, unless they would rather be wanting to themselves, or the cause which they defend. A certain learned Man would needs extort this from me, being busied about far other matters. For those Theses which he had before objected against, he hath endeavored now lately by a peculiar Writing to refute. In which Writing there are many witty and learned Passages: but I find that fault in the Author, which the Ancients found in *Albutius* the Rhetoritian, who made it his Business in every Cause he pleaded, not to say all that should be said, but all that he was able to say. Also that Motion of the Blood which is evident in live Dissections, he hath never labored to observe: just as if the matter might better be conceived by the Mind, then he could see it with his Eyes. But these and other things concerning those Theses, I leave to the Care of *Roger Drak*, who is now a Doctor of Physick at *London*, a Man of an acute Wit and solid Learning: I shall only meddle with such things as shall seem to oppose the circular Motion of Blood. And in the first place, what it is that Blood-letting does teach us in this Case, concerning which that learned Man hath observed things worthy of Consideration.

The occasion of this second Letter.

Answer to the Objections.

That in Blood letting the Vein does swell at the binding.

Not through Pain.

Not by straining the Vein;

A Surgeon being to open a Vein, makes a Ligature upon the Arm, that the Vein may swell. The Vein *that* swells, not on this side the Ligature towards the heart, but on that side the Ligature, which is furthest from the Heart. Now the Cause of that Tumor is not Pain, caused by binding the part: for oftentimes little, and commonly no pain in the part bound. And when the Arm is pinced or pained by Burning or otherwise, it hath its Veins for the most part less swollen, then upon a simple and bare Ligature.

Nor is it more likely, that the Veins swell upon the Ligature, because through the Veins which are straiter because they are bound, greater plenty of Blood comes and with more swiftness from the Liver; as about Bridges and in other places, Rivers being straitned do run more swiftly. For the Water of a River being gathered

thered together in a narrow place, is manifeſtly lifted up into a ſwelling, from which when it falls, it goes the faſter: but the arm being bound the contrary happens; for they are not the Veins nigheſt the Liver, from which blood ſhould come, but thoſe fartheſt from the Liver which are moſt diſtended.

But becauſe the motion of the Blood is ſtopped.

It remains therefore, that the Veins ſwell beyond the Ligature, becauſe the motion of the blood running from the ſmall veins into the Heart, is ſtopped by the Ligature, and being there gathered together, diſtends the Vein. But to the end I might be more certain hereof, I bound the jugular and crural branch, in living Creatures very ſtrongly with a threed, ſo that no blood might paſs by; and I opened that part of the Vein which was more remote from the Heart, it bled plentifully, ſwiftly, vehemently, ſoon after I looſed the band, and cut the Vein aſunder through the middle, and the part thereof fartheſt from the Heart being drawn out of the body upwards, preſently and ſwiftly fell a bleeding: whilſt in the mean time the part of the Vein neareſt the heart, being ſomewhat elevated, leaſt the Creature ſtrugling with pain ſhould eaſily force out the Blood; firſt it voided but little, and afterwards no blood at all. whence it ſeemed to me apparent, that the blood came out of the veins far from the heart, into thoſe near the ſame, and not out of the greater Veins into the leſſer; unleſs haply ſome neighbouring blood finding a way might ſlip away. Any one may eaſily try as much in opening a vein in the Arm: for if he force the blood above the Ligature upwards with his finger, ſo that the vein appear empty, yet ſhall he ſee the blood iſſue out as faſt as ever below the Ligature; which could not come through the upper branch being at preſent empty.

Nor doe the Arteries ſwel becauſe of the Ligature.

But if the Vein be thus diſtended with blood, which is moved from the ſmaller veins to the Heart, how can the artery be diſtended upon the ligature, which divers excellent Phyſitians relate to have been ſo diſtended, that it has been opened inſtead of a vein; the truth is, the Artery doth not ſwell upon the Ligatures being made, unleſs where it is neer the Heart, but farther off it falls in ſomewhat, and is diminiſhed, as I have an hundred times and oftener experimented in the Diſſections of living Anatomies. But I do not think it was any of the authors, meaning that the remoter part of the Artery was diſtended by means of the Ligature, but that their meaning only was, where the Vein did not appear which was to be opened, that there the place where it lay was to be ſought by feeling; and that by a pit, by motion and ſwelling of the Blood it was to be found: and when we feel a ſwelling, or otherwiſe diſcover the ſame, we ſhould not preſently conclude that there was the Vein; for it might be an Artery which by reaſon of the hard binding had loſt its pulſe, and which by reaſon of the thickneſs of the Coates not quite falling in, might counterfeit a certain tumor and puffing-up as it were.

But the Veins ſwel alſo with two Ligatures, and wherefore.

But moreover if the Vein ſwels by reaſon of the Blood returning to the Heart, why does the vein alſo ſwel and if opened, why void Blood, when there is a Ligature made below as well as above the place phlebotomized? which Blood cannot be thought poſſibly to come from the lower parts, by reaſon of the Ligature made below the Orifice. But this does not alwayes ſo happen, but ſometimes, only when the Arm is tied at a certain diſtance, and then the greater Veins in the place between thoſe two Ligatures do receive that blood from the ſmaller Veins, which ſmaller Veins receive from the ſmaller Arteries, which are joyned to the ſmal veins by way of Anaſtomoſis. And that indeed the blood which flows out betwixt the two Ligatures, does come by way of Anaſtomoſis out of the Arteries, this is a ſign and in that it flows more hotter and with more violence, and more eaſie and ſooner a Lipothymia or fainting fit follows the efflux hereof. And this Ligature I am wont to make uſe of, when I have ſigns that ſpirituous and hot blood is in fault, and I bid the Chirurgeon ſeek out thoſe Anaſtomoſes, by his Ligature: for if the Ligature be made above the Anaſtomoſis, it ſtops the motion of the blood; but beneath it does not ſtop it, but the blood leaps out hotter to the feeling of the Patient.

Why in bloodletting they unbind the Arm, when the blood does not run apace.

When a Vein is opened and the blood runs out, as ſoon as it begins to ſtop or come away ſparingly, or if it did ſo at firſt, we looſe the Ligature, that the blood might run out faſter. Now the Ligature ſeems not therefore to be ſlacked, to the intent the blood may come from the Liver through the Veins. For though there be little or no blood above the Ligature, yea only a pit appear in the Vein, yet will the courſe of the Blood be increaſed by looſening the Ligature, which cannot poſſibly come out of an empty Vein. But by the looſening of the band, the Blood may the better deſcend by the Arteries, and paſs out of them into the Veins; becauſe the Arteries being compreſſed by the Ligature, by looſening the ſaid Ligature become more free. Now that the Arteries are not alwayes ſufficiently at Liberty when the arm is bound, the patient himſelf can witneſs, who oft perceives the pulſe of the Arterie at the Ligature, which perception the compreſſed Arterie cauſes, when it ſmites againſt the fleſh. And the Phyſitian if he examine the matter, ſhall often find a leſs pulſe in the bound arm then in the free. And I can teſtifie that I have divers times applyed my fingers to the Patients wriſt, when the band was to be looſed, and obſerved, that when by looſing the Ligature Blood came in more plentifully, the Pulſe became greater.

Why much blood may be taken away.

But if that Blood which flows out when a vein is opened, comes out of the Arteries into the veins, how can it be plentifully taken away? for all the Arteries pulſe equally, and therefore they ſeem to afford blood to the Veins in one and the ſame meaſure: and if ſo be the reſt of the arteries afford ſo much to their veins as the arteries of the Arms do to theirs and is drawn out, ſhall not the heart be ſoon deſtitute of all blood? There is truly no danger at all: For we have ſaid the blood comes as faſt unto the heart, as it is driven thence

Yet I cannot conceive the Blood enters all veins alike, although the Arteries ſeem to pulſe equally; for all Liquors flow more eaſily and ſwiftly into an empty place, in which there is nothing to drive and force them, and moreover in this caſe the Blood is more forcibly drawn by the empty Veins then by the full ones.

And more out of the Arm then out of the Hand.

Now more ſtore of Blood iſſues from a vein opened in the cubit, then in the Hand, becauſe all that blood, which comes to the Veins through all the Anaſtomoſes of the Cubit of the Hand, muſt return through the Cubit Veins;

but leſs runs through the Veins of the Hand, and that only, which comes through the Anaſtomoſes of the Hand.

Why it flows out of a wounded Arterie not bound.

Out of a wounded Arterie, indeed the blood preſently flowes, although it be not bound. But that happens becauſe the Blood is carryed with greater vehemence, though the arteries then through the Veins; by which vehemency, it fills the Arterie, lifts up and diſtends the Coat, and if it be opened, neceſſarily flies out.

The Ligature being looſed, the blood ſtops, and ſometimes it runs, and why?

Out of a Vein opened when Blood has flowed ſufficiently, we ſtop it by untieing the Ligature, becauſe the Blood may be carried again its old way, now it is at Liberty and the way free. But if it ſo happen, that too much blood being gathered about the Ligature, the Veins cannot give it a free paſſage; or ſo large an orifice be made, that the Blood may now go right out that way, by which it went, when it was ſhut in, ſometimes the Band being looſened, the blood runs out in a full ſtream.

Which our Chyrurgeons at this very day, that they may effectually ſtop, they frequently compreſs the vein

But is ſtopped by holding the finger in the Vein below the Orifice.

with their Thumbs a little below the Orifice, and ſo they ſtop the blood; leaſt if they ſhould compreſs it above the orifice, the blood contained therein ſhould preſently curdle, and hinder the healing up of the Vein. And they that deny that the blood may thus be ſtopped, I know not wherein we ſhould credit them who would abuſe us in a thing obvious to the Senſes. And ſeeing the Blood is ſtopped by compreſſing the lower part of the Vein, it is truely manifeſt that the Blood aſcends from the lower parts.

Alſo when the Vein is cut aſunder in the middle and wherefore,

But in caſe it ſhould happen, not in Blood-letting, but by ſome other miſchance, that a Vein ſhould be ſo wounded, that the Blood could not be ſtopped, the Vein is cut aſunder in the middeſt: Whereupon, the Vein being no longer ſtretched out as before, the parts cut aſunder are drawn upwards and downwards into the fleſh, by which fleſh the mouths of the Veins are compreſſed and ſhut, and that ſo much the more eaſily becauſe the Blood can move its ſelf ſo much the more eaſily through the neighboring veins which are extended and open, the former being ſhut up, and therefore for the very ſame cauſe a ſmall Arterie being cut aſunder athwart, neither Bleeding nor Inflammation do follow.

Which things being ſo, I conceive it is evident to all Men, that ſuch things as happen in Blood-letting, do either prove the Circular motion of the Blood, or at leaſt are not againſt the ſame.

No parts receive Blood by the veins excepting the liver.

But ſeeing other Things are objected againſt us, we muſt anſwer them alſo. And firſt whereas they prove that the Blood comes through the Veins, not out of the Arteries, but from the Liver; becauſe ſome parts receive Blood, and have Tumors ariſing from the Afflux of the Blood, which parts have no Arteries, amongſt which they reckon the Pleura. But it does not follow, if the parts have not Arteries, that their veins do not receive their blood from the Arteries, but from the Liver; for as we ſaid, the blood out of the Meſenterick and Celiack Arteries does not enter the Meſenterick and Splenick Veins, through which it is carried to the Liver: even ſo other veins may receive blood from the Arteries, which they may carry into a part more remote from Arteries. Howbeit there is no part of the Body of any bulk, wherein the Anatomiſts do not rightly acknowledge Arteries to be. And infinite Arteries do not as yet lie concealed from their knowledge, becauſe the ſmalleſt Arteries diſperſed through the fleſh, have only one Coat as the Veins have. Yea, and in the Liver it ſelf, there are ſo many branches of the *Arteria Celiaca*, as there are Branches of the *Vena Porta*, and as many branches alſo there are of the *Ductus Cholidocus*, all which have bin by Anatomiſts hitherto reckoned for Branches of *Vena Porta*, becauſe thoſe three kinds of Veſſels are in the Liver incloſed in a common Coat. At leaſt no man will ever deny the Arteries of the Pleura, that has once ſeen the Cheſt of a living Creature opened; for whilſt the Cheſt is diſſected, Blood is wont to leap out of the Arteries of the Pleura.

Moreover they prove that Blood does not come out of the Arteries into the Veins, becauſe the Arm being ſo bound, that the Arteries may ſtill pulſe, the arm is not immeaſurably ſwelled below the ligature, whereas it ought to be ſo ſwollen and diſtended, if by reaſon of the Ligature nothing can flow back into the greater Veins, and at every pulſe, the Arteries drive ſomewhat into the lower veins, at every contraction, of which Contractions there are more then three thouſand performed every hour. Nevertheleſs, it may come to paſs that the Arm is not extended to ſuch a bulk when it is bound; becauſe the veins are not totally ſhut up, and the blood may by ſome creeping holes paſs under the ligature, and go into the greater veins: as we ſee a part being cloſely bound to repel Humors, for divers months or years, is nevertheleſs nouriſhed by the blood which flows through; alſo it may come to paſs that ſo little Blood is forced in through the Arteries of the bound Arm, as that it cannot diſtend, or Swell the ſame under a long time, for that Blood only is forced in, the veins being ſtretched with fullneſs, which is in the Arteries from the Ligature unto the Hand; for that which is above the Ligature, can enter more eaſily into the veins, by open Anaſtomoſes. Yea it may come to paſs, when the veins being diſtended, do no longer permit the Blood to be forced into them by the Arteries, that the pulſe of the Arteries is ſtopped, or that the Blood regurgitates upwards, and enters the Veins above the Ligature, through the Anaſtomoſes: the like whereto I ſaw in a Duck, as I formerly related. Unleſs one of theſe things happen, the Arm would preſently ſwel after it is bound, and a ſuffocation of the innate Heat, by the Abundance of Blood driven in would follow. For I have often bound mine own and others Armes above the Wriſt, and I alwayes ſaw the veins diſtended, and the Fleſh to ſwell ſomewhat and grow red; and oftentimes though not alwayes, the arteries abated by little and little of their pulſe, yea and ſometimes intermitted; and afterward the red colour of the bound Arm was changed into black and blew: and therefore I preſently undid the Ligature, being frighted with this Example. A certain Country-man being wounded in the inſide of his Arm about the Cubit, when the Village Chirurgeon could not ſtop the blood, he bound the Arm extream cloſe about the Wound, whence followed an exceeding Inflammation of the lower part of his Arm, and ſuch a ſwelling, that deep pits were ſeen in the place of his fingers joynts, and within eighteen hours, the lower part of his Arm was gangrenated and ſphacelated, which *Chriſtianus Regius* an expert Chirurgeon did cut off, in the preſence of my

ſelf

ſelf, and *Ewaldus Screvelius* an excellent Phyſitian.

How and why the venal blood differs from the arterial.

Moreover they object, if the venal Blood comes out of the Arteries, how can the arterial Blood differ ſo much from the venal? But we muſt know that it differs leſs from the venal Blood, then moſt men imagine, who from the violence wherewith the arterial Blood leaps forth, do collect the great plenty of Spirits therein, and the great rarity or thinneſs thereof: whereas that Leaping proceeds from the Force wherewith the Heart drives the Blood through the arteries; for an Arterie being opened below or beyond the ligature, the Blood comes out only dropping. And the difference between theſe two bloods is cauſed by the greater or leſs quantity of Heat and Spirits, according as the Blood is more or leſs remote from the Heart the fountain of Heat. For the Blood which is near the Heart differs much from that which is far off, in the ſmalleſt arteries, which you can hardly diſtinguiſh from that which is in the ſmall veins. And the ſmaller veins have more thin and hot Blood, then the great ones; which any one may eaſily try in opening veins of the Arm and Foot. Yea, and if the Vein be opened with a double Ligature on each ſide the orifice, as I ſaid before, the Blood will come out hotter then with a ſingle Ligature.

How menſtrual Blood is collected about the womb.

Now that the Blood does not go out of the ſmaller veins into the greater, they endeavour to prove by womens monthly purgations, which according to their judgment, are gathered one whole month together in the Veins about the Womb; and if they are carried from the Womb unto the Head, they conceive that they do not paſs through the *Vena cava* and the Heart. Howbeit, the common and true opinion is, that about the time of the uſual flux, the blood begins to be moved to the Womb, from which motion of the humors, pains of the ſides and loines are wont to ariſe about that time, And I know by Experience, that about the time of the menſtrual Flux, if the Pulſe of the Heart and arteries can be made greater, the Courſes will flow the better, becauſe the Blood will through the arteries be driven more forcibly into the Womb. It may nevertheleſs fall out, that the Courſes may be collected and make an Obſtruction in the Womb, and that then the Blood may not return into the greater veins, that motion being ſtopped: but that is beſides nature.

How they are carried out of the Womb into the Head.

And when the menſtrual blood is carried out of the Womb into the Head, the way is not inconvenient, through the *Vena cava*, the Heart, and the aſcending branch of the *Arteria Aorta*, and that they do indeed paſs through the Heart, thoſe palpitations and light faintings do ſeem to argue, which are wont to attend upon the Courſes ſtopped.

How it comes that the Humors paſſing through the Heart, do not cauſe great Inconveniences.

But ſhould we not conceive it to be a dangerous thing, if all the ill humors in our bodies muſt paſs into and through the Heart. But we muſt know, that our bodies are ſo framed, as that they may be moſt convenient for us when we are in Health, and not when we are ſick. Moreover the Humor which putrifies by reaſon of obſtruction and is very bad, comes not to the Heart, becauſe its way is ſtopped up. Nor is the Heart ſo weak as to be corrupted by an evil Humor, which ſtayes not long therein: for thoſe great Phyſitians *Galen*, *Hollerius*, *Laurentius* have obſerved that the Quittor of ſuch as have an Empyema, and other ſharp and ſtinking Humors, do critically and without any bad ſymptomes, paſs through the left ventricle of the Heart which many times makes for the good of the ſick Perſons, in whom that bad Humor paſſing through the Heart, is often vanquiſhed by the Vigour and Vertue hereof.

The Objections againſt circumſtances.

The other Objections which they make, do only reſpect the Cauſes of this motion or certain *Circumſtances*, wherein men are wont more freely to diſſent, yet let us breifly conſider whether or no they have in them any weight, wherewith to burthen our Opinion.

Nothing hinders, but that half an ounce of Blood may be forced out of the Heart, at every pulſe.

They ſay that at every contraction of the Heart, the blood is not driven out by half ounces, nor by drams, nor by ſcruples, out of the Heart of a Man, for three Cauſes: firſt becauſe that blood is too ſpirituous, but I have already ſhewed that it is not ſo ſpirituous as men imagine commonly: ſecondly becauſe thoſe little Valves of the Heart, do only gape a little, and then are cloſe ſhut again, which alſo doth not agree with experience: for an Arterie being cut off from the heart, great ſtreams of Blood do iſſue from the Heart. Thirdly that the Arteries are too full then to be able to admit half an ounce, a dram, or a ſcruple of Blood. But that is too inconſiderately avouched; for when the Heart contracts it ſelf, all the arteries in the body are enlarged, and that on all ſides, as I have divers times perceived with my hand, holding the naked arterie betwixt my fingers. And who will now ſay, that all the Arteries of the Body being dilated, cannot admit of a Scruple, a Dram, yea half an Ounce of blood, more then they have?

Nothing hinders but that the Blood may be circularly moved in the child in the Womb.

Alſo they deny that in the child in the Womb, the blood out of the Vena Cava, does through the Veſſels of the heart united enter into the *Arteria Aorta*, and go from thence out of the umbilical Arteries into the umbilical Vein, and return back by it into the Heart: becauſe they think this great abſurdity will follow, that one Vein ſhould carry the mothers blood and withal ſo much blood as the two umbilical arteries do bring in. As if Rivers did not frequently carry as much water in one Channel, as many Brooks are able to bring in. And here the umbilical Vein when it is but one, is much greater then the Arterie. There is often but one arterie or there are two veins; that the arteries may as much as may be anſwer to the veins. *In brute Beaſts (ſayes* Fallopius *a rare Anatomiſt) there are allwayes two Veins and two Arteries, which with the Vrachus or piſ-pipe do reach as far as the Navil, and the Veins do preſently grow into one before they enter into the Abdomen which does reach to the Gates of the Liver, as I have obſerved in all Sheep, Goats, and Cows, whoſe young ones I have diſſected, But if they ſpeak of the Child in a Womans Womb, I avouch that ſometimes I have not ſeen the two umbilical Arteries, but only one Arterie and one Vein aſcending together with the Vrachus to the Navil: where the Arterie is again divided into two, which afterwards go unto the ſides of Os ſacrum.* And that indeed thoſe Veſſels of the Heart are united in a Child in the Womb, that the blood may paſs that way out of the *Vena Cava* into the *Aorta*, Waterfowl, as the Duck, Gooſe, and ſuch like do ſeem to teach us;

A ſign that it is ſo indeed.

which

Which because they cannot often breath under the water, nor dilate their Lungs, nor consequently admit the blood that way, they have those unions of the vessels of the Heart, when they are grown up. Which also *Harvey* notes in his 6. Chapter.

Though there be Anastomoses of the Veins & arteries, yet Tumors may arise.

Also they deny the frequent Anastomoses of the Veins and Arteries, for if such there were, they say tumors would not arise by Fluxion and Congestion of Humors. As if Rivers though they have outlets, receiving over-great plenty of water, may not overflow the neighbouring fields; nor can the blood shed out of the Vessels, because it congeals, easily return into them again. Moreover Tumors are many times caused, for as much as by reason of Obstruction, the bloods passage is stopped: and because by heat and pain it is drawn into the flesh.

Now those Tumors seem rather to favour the Doctrine of the bloods circular motion, because they happen through cold, bruising, and all stoppage of the passages of the Body; and because with *Aqua vitæ* or some such medicine, the Humors and the Tumors being often made fluid, it is by this motion of the blood drawn into the Veins; and the Tumor by that means sooner cured then by repulsion, revulsion, concoction or dissipation.

Not by Rarifaction.

Touching the *Cause of the Bloods motion*, difficulties do also present themselves unto us; and when we deny that the blood according to the Course of Nature, is so suddenly and vehemently rarified in the Heart, as to be able to move the Heart, the blood of the whole Body, and the Arteries themselves; those famous men the Ring-leaders of this opinion, do suppose that they do hereby prove it, *In that while we are cold, all the Veins of our Body are contracted, and can hardly be seen, whereas afterwards when we grow hot, they do so swell, that the blood contained in them, seems to take up ten times so much space as before it did.*

As for me, this truly is my Opinion, and thus I perswade my self, that seeing they have now divers times, so diligently endeavored in Publick to perswade men to embrace this their Opinion of Rarifaction; and have dissected and lookt into the Hearts of Living Creatures, nor have yet dared to say, that they could sensibly perceive any such Rarifaction of the blood in the Heart: I say, my Opinion is, that they could not indeed and in truth observe any such Rarifaction of the blood in the Heart, and as they would in this place maintain: And it will be easie for him that is a little verst in live Dissections, to see that there is no such rarifaction. And therefore though it might be proved, that such a Rarifaction of the blood, does sometimes happen præternaturally, yet ought not the cause of the Natural motion of the Heart, Blood and Arteries be therefore attributed thereunto.

Yet in the Example which they propound, I do not see what certainty there is that the blood by reason of its Rarifaction does possess ten times more space then before. For might not that same Tumor of the external Veins easily arise, because whereas before the veins were contracted and straitned through cold, they could not receive much blood, and therefore they could not swell: Which cold and straitning of the vessels being afterwards taken away, and the Veins being loosned by heat, they might admit much blood, which is driven into them by the heart, and so appear full and swelling. That this is not the least cause of the tumor of the Veins, persons that are feaverish seem to teach us, who if they thrust their arms into the cold, have not their Veins so swelling, but if they keep them warm under the cloaths, they have them very full and swoln, which tumor if it came from Rarifaction, it ought to be in both cases alike, seeing that in them, the bloods Rarifaction proceeds from an internal cause.

Nor do I conceive that it is also void of Question and undoubted, that when we are first cold, and afterwards grow hot, the inner Veins as well as the outer do swell. For it is much to be suspected, that the inner parts do possess less blood and heat before; because by that cold wherewith before they were not hurt, if when we are so heated we drink cold drink, they are wonderfully weakened. Doubtless as the inner veins are oftentimes the treasury of the blood, wherein the blood is stored up for future uses, so may the external Veins be the like treasury, and they appear to be when they so swell as aforesaid.

But by constriction of the heart the blood is driven in the Arteries.

These men themselves when they observed that this also was much against their Opinion, that we asserted that the blood was manifestly poured out, at the constriction of the Heart; they avouch that *that* is not the constriction, but the dilatation of the heart which we mean. But that we were deluded by a certain appearance, because in our constriction, there was a constriction only at the Basis, but about the tip a true Dilatation; which Invention when others saw that it could not hold, least they also should seem to desert their cause, they invented that there is a constriction indeed, in the Cavity of the whole Ventricle, but in the pits and passages of the sides, especially in Dogs, there is a certain kind of Extension and true Dilatation.

But truly, the upper part of the Heart is not seen to be dilated, when the lower is contracted; save when the Creature is dying, and that the waving motion of the Heart is caused by the impulse of the blood. Nor can we observe one Dilatation or Constriction of the Pits, another of the Cavity of the Ventricles. Only a certain progressive motion is observed in a large Heart, because the Dilatation or constriction doth evidently begin at the basis, and sensibly proceeds to the tip, although 'tis performed all welnear in a moment. And that I might be perfectly assured, that the Heart was contracted within likewise, on all sides, having cut off the tip of each Ventricle, I put my thumb and fore-finger into the living heart of a Dog and a Rabbit; and I manifestly felt the sides of the Heart to press my fingers to the middle partition, equally in the middle, tip and Basis; and that the pits in greater Beasts, became to Sense, not bigger but lesser. And soon after the Constriction abating, that the sides of the heart above, beneath and in the middle were loosned, and the pits did feel evidently larger. But in the Septum or partition wall it self, no motion is felt, save that the Spirits seeking egress make a kind of Palpitation, when in Creatures at the last gaspe, the motion of the right Ventricle ceases, the Septum follows the motion of the right Ventricle.

Not in the dilatation, though sometimes blood go out therein.

Now they would have it nevertheless that naturally the blood is poured out in the widening of the heart, and not in the Constriction or straitning thereof, because in the wounded Heart of Living Creatures, the blood is seen to come out when the Heart is dilated. And this is sometimes true; but that which they thence collect, our very Senses teach us to be untrue. For either the Dog or other creature is placed with its Head and breast elevated, and

the

the belly low, and so the wound is inflicted into the Heart, in which case, seeing the blood which enters through the *Vena cava* and *Arteria venosa* into the Heart, is higher then any wound of the Heart, it, as soon as it is entred, which is at the beginning of the Dilatation, flows out, not because of the Pulse, but of its own heavines, and therefore it is not by any force made to flie out to some distance, as it happens in the Pulse of the Arteries. But if as it ought to be, the dog be laid on his back, his head and belly resting on the same plane, and the wounded Heart be raised with a mans fingers, as long as there is any strength in the Heart, it sooner by Constriction casts out the blood it hath received, at a distance, then the whole Heart is filled or widened. But when the strength of the heart decayes, and that it seldom straitens it self or not at all, because the Earlets are more strong, and do still continue pulsing, even when the Heart quite gives over; the blood being driven by the Earlets enters the heart, is there collected, and when more is come in then the Heart can contain, it goe out at the wound, not with violence, as it must do to cause Pulsation, but with a gentle motion, drop after drop. So that our Sense can perceive no strong motion of the blood, save in the Hearts Constriction.

And being driven by all parts of the Veins, it returns to the Heart.

Now they will have the blood to return through the Veins into the Heart, only because the blood being forcibly driven to the Parts, as water poured into an horn, does regurgitate or abound back upwards, and so is carried back unto the Heart. But I have already shewed tokens, that the blood is either drawn, or driven by all the parts of the Veins: besides which I have also these following: in that the Heart being taken out of the body, the motion of the blood, and that swift enough, is still seen in the Veins. And if a Vein, yea a milkie one, be tied in two places, that same Ligature being only loosned, which is neerest the Heart, while the parts are yet hot, the Chyle will still be moved to the Liver, the blood unto the Heart, which could neither by any step be driven from the Heart through the Arteries, nor from the Guts through the *Venæ lacteæ*; nor would it by its own fluidity move rather upwards then downwards.

By this motion the Veins and Arteries may be nourished.

But let us answer the remaining objections: They suppose, if the blood should be moved so swiftly, that the Veins and Arteries could not conveniently be nourished. But a dog can quench his thirst, drinking at the River *Nilus* and running as he drinks; but here the parts stay at the brook side: and whatever they have drawn from the blood, they treasure up in their own substance, least it should be washed away, by the running by of the humor.

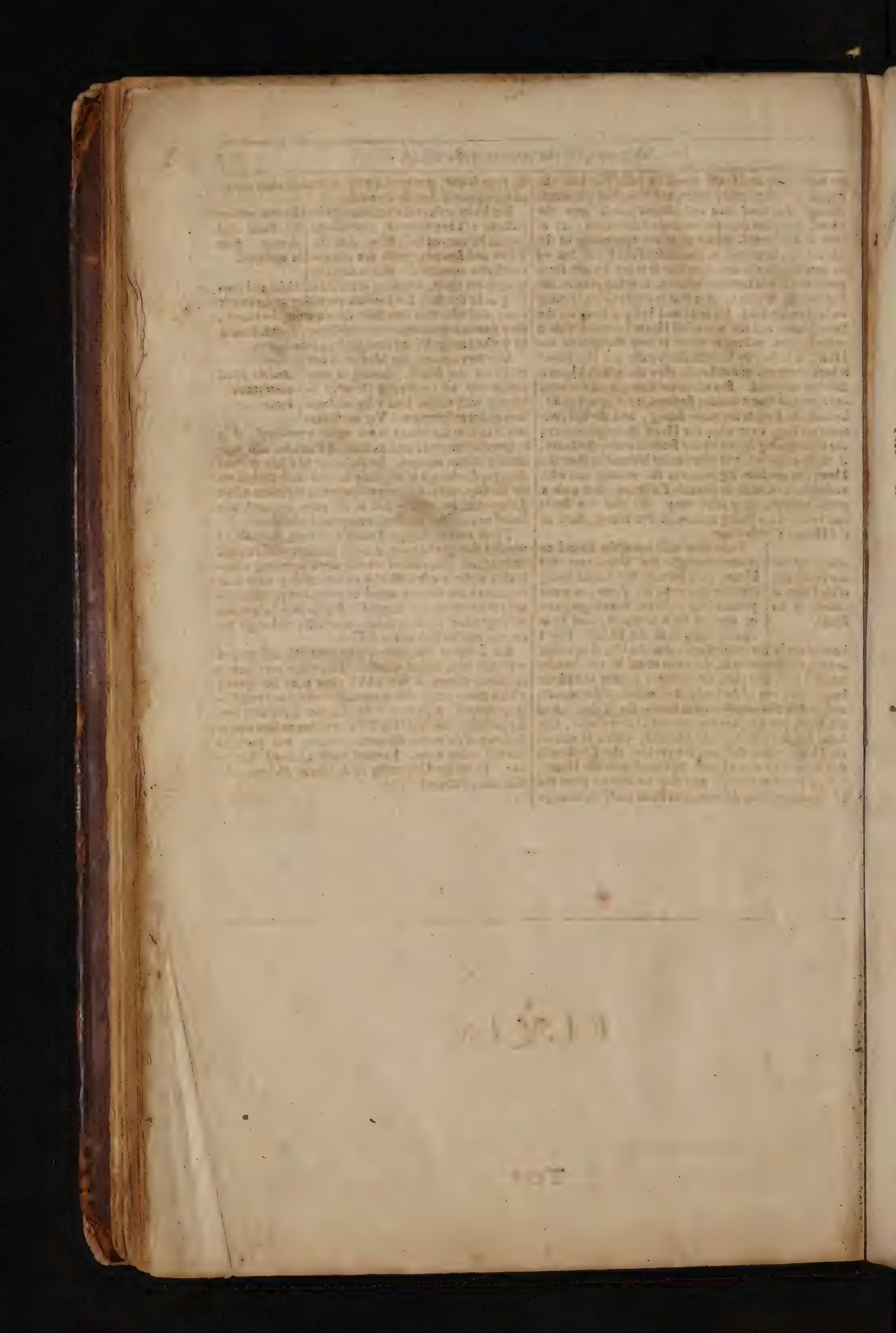
And the blood ventilitated better.

Also they conceit this Motion is not useful for the blood. Seeing it may sufficiently be conserved (since it abounds with native heat) by respiration and transpiration. Yet most certain it is, that the blood is yet more ventilated, if it be speedily moved, and its smallest Particles also agitated with this motion. So the water of a lake or standing pool, though it be gently moved and fanned on the Surface, yet is it corrupted; when in the mean while Rivers that are totally and in all parts agitated, are found to continue most uncorrupt and wholsom.

These are the things (most excellent *Bartholine*) which I thought fit to joyn to the former, that I might satisfie those who cannot receive a new opinion, wherin they observe any difficulty or obscurity; who many times have neither mind nor time to enquire exactly into the bowels thereof. But in my Judgment, we ought not to deny things manifest, although we cannot resolve such as are difficult.

But I never was disposed to contend and quarrel with any man about words. There are very many excellent things about which time may be spent; which many times also is not sufficient for our necessary occasions. Also from a Scoffer that seeks after her, Knowledge does hide her self away, but to him that is studious of the truth, she comes to meet, and presents her self to his view. Farewel most Learned *Bartholine*. From the University of *Leyden* in *Holland*, the Kalends of *December* 1640.

FINIS.



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ἀειδῶν. τῶ ἀειδῶντος. ὁ. optima faciens, un
circunflexa.
ἄριστον. τὸ ἄριστ. τὸ. prandium, antepenacuitur.
ἄριστον. ἴστ. τὸ. optimum, similiter antepenac.
ἀρνεῖ⊙. τῶ ἀρνείᾳ. ὁ. agninus, antepenacuitur.
ἀρνός. τῦ ἀρνεῦ. ὁ. agnus nuper natus, acuitur.
ἁρπαγή. ἡ. ἁγῆς. rapina, acuitur.
ἅρπάγη. τ. ἅγης. hamus, penacuitur.
ἀῤῥήτος. ᾰ. ὁ. arcanus, non dictus, antepenac.
ἀῤῥήτός. ἀῤῥητᾰ. ὁ. odiosus, acuitur.
ἀρτεμής. ἀρτεμέ⊙. ὁ. integer, acuitur.
ἄρτεμις. ἀρτέμιδος. ἡ. Diana, antepenacuitur.
ἀρτιτόκος. ἀρτιτόκᾰ. ἡ. nuper enixa, penac.
ἀρτίτοκ⊙. τόκᾰ. ὁ. nuper natus, antepenac.
ἀρτίτομος. ὁμᾰ. ὁ. nuper incidens, antepenac.
ἀρτιτόμος. ἀρτιτόμᾰ. ὁ. nuper cæsus, penacuitur.
ἅοσα. δασωόμδῶ. quæ, neutri generis, aspiratur.
ἄοσα. ψιλόμενον. quædam, attenuatur.
ἀστήρ. ἀστέρος. ὁ. stella, acuitur.
ἄστηρ. ἄστηρ⊙. ἡ. Aster urbs, penacuitur.
ἀσφοδελός. ᾰ. ὁ. locus apud inferos, acuitur.
ἀσφόδελος. ἀσφοδέλᾳ. ὁ. albutium, antepenultima acuta.
ἅπᾰ. δασωόμενον. quæ, cum aspiratione.
ἄπᾰ ψιλόμενον. quædam, sine aspiratione.
ἅπᾰ. Ὅμηρ⊙. Ἰλιάδος Θ. φοῖνιξ ἅπᾰ γεραιέ. λέγ δ ἀχιλλεὺς πῶς τὸν φοίνικα. uox est qua minores honorant maiores. Home. Phœnix atta senior, inquit Achilles ad Phœnicen.
ἀτεχνῶς, ἐπῤῥημα. uerè, sedulò, anflectitur.
ἀτέχνως, ἐπῤῥημα. sine arte, penacuitur.
ἄτροπ⊙. ἄτρόπ. ὁ. ἡ. immutabilis, antepenac.
ἄτροπος. ἀτρόπ. ἡ. Atropus parca.
αὐγή. αὐγῆς. ἡ. Auge mulier, penacuitur.
αὐγή. αὐγῆς. ἡ. splendor, aurora, acuitur.
αὐτή. τ. ταύτης. ἡ. ipsa, penacuitur.
αὐτή. ἡ. αὐτῆς. ἡ. hæc, acuitur.
ἀφετή. ἀφετῆς. ἡ. dimissio, acuitur.
ἀφέτη. ἀφέτης. ἡ. Aphete insula, penacuitur.
ἄφρος. ἄφρ. Apher, penacuitur.
ἀφρός. ἀφρᾰ. ὁ. spuma, acuitur.
ἄχυρον. ὑρ. τὸ. palea, antepenacuitur.
ἀχυρών. ἀχυρῶνος. ὁ. stabulum palearũ, acuitur.
ἄωρ. ἄωρος. τὸ. ensis, penacuitur.
ἄωρ. ἄωρος. ὁ. mulier.

Βαιόν, ἐπῤῥημα. paulum, acuitur.
Βᾶον. Βᾶι. τὸ. ramus, penanflectitur.
Βαιός. Βαιοῦ. ὁ. breuis, acuitur.
Βαῖ⊙. Βάϊον. ὁ. Baius Vlyssis socius, penultima anflectitur.
Βασίλϊα. Βασιλείας. ἡ. regina, antepenacuitur.
Βασιλεία. Βασιλείας. ἡ. regnum, penacuitur.
Βάτος. Βάτ. ὁ. cadus. penacuitur.
Βάτ⊙. Βάτ. ἡ. rubus, penacuitur.

Βῆλος. Βηλ
Βηλός. Βηλοῦ. ὁ. c
Βῆσσα. δᾶ ἑνός σ.
Βῆσσα. δᾶ δύο σ. concauitas, penanfle
Βίος. Βίᾳ. ὁ. uita, uictus, penultima acuta
Βιός. Βιοῦ. ὁ. arcus, ultima acuta.
Βίοδς. Βιότ. ὁ. uita, antepenultima acut
Βιωτός. Βιωτδ. ὁ. uiuendus, acuitur.
Βλῆχρον. χ. τὸ. herbæ species, penanflect
Βληχρόν. Βληχροῦ. τὸ. infirmum, acuitur.
Βοῶν. ῶνος. ἡ. custodia apud Alexandr
acuitur.
Βοᾶν. Βοῶνδς. ὁ. clamans, circunflectitu
Βροτός. Βροδῦ. ὁ. homo, mortalis, acuitu
Βρόχος. Βρόχ. ὁ. tabo, sanies, penacuitur
Βρωτός. δᾶ τῦ ω μιγάλ. comestibilis, a
Βροῦχος. χ. ὁ. bruchus uermis, penanfle
Βρυχός. Βρυχοῦ. ὁ. præco, acuitur.
Βρύων. Βρύονδς. ὁ. scaturiens, penacuitu
Βρυῶν. Βρυῶνος. ὁ. littus Cyrines, anfle

Γαλάτϊα. δᾶ τ. ᾱ. Galatea Nereis,
nacuitur.
γαλατία. δᾶ τ. ι. Gallia regio, pen
γαλήνη. γαλήνης. ἡ. galene, mare, pena
γαλήνη. γαλήνης. ἡ. tranquilla, acuitur
γαυλός. γαυλοῦ. ὁ. situla, uas pastorale, ac
γαῦλος. χ. ὁ. nauigium onerarium, pena
γέλοιος. ridiculus, antepenacuitur.
γελοῖος. qui risum mouet, penanflectit
γέλων. γέλων⊙. ὁ. Gelon uiri nomen,
γελῶν. γελῶνδς. ὁ. ridens, circunflectit
γενετή. γενετῆς. ἡ. natiuitas, acuitur.
γενέτη. γενέτης. ἡ. stirps, penacuitur.
γεραιός. γεραιᾰ. ὁ. senex, acuitur.
γεραῖος. γεραίᾳ. ὁ. Geræus gentile, pena
γῆρας. senectus, ætas.
γήρασις. ad senectutem profectio.
γλαύκη. γλαύκης. ἡ. cæsia, acuitur.
γλαυκή. γλαυκῆς. ἡ. Glauce mulier, per
γλαῦκος. γλαύκ. ὁ. glaucus, cæsius, per
γλαυκός. γλαυκοῦ. ὁ. Glaucus, uiri & pis
men, acuitur.
γῦρ⊙. γύρ. ὁ. ambitus, gyrus, penanfl
γυρός. γυροῦ. ὁ. rotundus, acuitur.

Δάφνη. δάφνης. ἡ. laurus, penacu
δαφνή. ῆς. ἡ. Daphne puella, acu
δείνη. ης. ὴ δφνή. δφνῆς. ἡ. mala,
δεινός. δφνοῦ. ὁ. grauis, acuitur.
δφρή. δειρῆς. ἡ. collum anterius, acuitu
δείρη. δείρης. ἡ. ciuitas Aethiopiæ, pena
δεκαετής. decennis, de tempore.
δεκαέτης. decennis, de reliquis.
δελφίς. κὰὶ δελφίν. delphin pisces, acu

ἀγελαῖος. τὸ ἀγελαίου. τῷ ἀγελαίῳ. ὁ. indo anflectitur.
ἀγελαῖος. τῷ ἀγελαίῳ. ὁ. rudis, antepenacuitur.
ἀγητός. ἡ ἀγητή. ὁ. admirabilis, acuitur.
. τὸ ἄγητος. ὁ. Agetus, nomen proprium.
ρα. ἡ ἀγκύρας. ἡ. ancora, antepenultima
ta.
κυρα. ἡ ἀγκύρας. ἡ. urbs Galatiæ, penacuitur.
ν. τῷ ἄγνος. ὁ. planta, penultima acuta.
ός ἡ ἀγνόος. τὸ. insciũm, ultima acuta.
ός τὸ ἁγνὸς. ὁ. purus, agnus, cum spiritu den
o & acuto, in fine.
ραῖος. ὁ. in foro educatus, antepenacuitur.
ιος. ὁ. forensis, penanflectitur.
γὸς. ὁ. dux, acuitur.
ἡ ἄγεος. τὸ. fœdatio, penultima acuta.
τῷ ἀγείῳ. ὁ. rusticus, antepenacuitur.
ος. ἡ ἀγρέως. ὁ. agrestis, penanflectitur.
ος. τῷ ἀγροίκῳ. ὁ. indoctus, rudis, antepe
ltur.
ος. τὸ ἀγροίκου. ὁ. habitans agrum, pe
flectitur.
μος. ὁ. in agro pastus, penacuitur.
μος. ὁ. in agro pascens, antepenac.
λος. ἀγχιάλου. ὁ. urbs Thraciæ, penulti
cuta.
ός. ἀγχιαλὸς. ὁ. ἡ. marinus, acuitur.
duerbium, prope, anflectitur.
mperatiui modi, suffoca, penacuitur.
τὸ ἄγοντος. ὁ. agens, penultima acuta.
ἡ ἀγὼνος. ὁ. certamen, ultima acuta.
ός. ἀδελφὸς. ὁ. frater, ultima acuta.
ς. ἀδελφὸς. ὁ. nomen propriũ, antepenac.
ς. ἀδολέσχης. ὁ. nugator, penacuitur.
κὸς. ἐ ος. ὁ. ἡ. contemplatiuus, acuitur.
ἀδρὰς. ἡ. crassa, aspiratur & acuitur.
ἀδρας. ἡ. urbs Illyrica, tenuatur & pe
ultur.
ἄσω. ὦ. ἧκα. canto, tenuatur.
ἄσω. ὦ. ἧκα placeo, aspiratur.
ος. ἡ ἀζομένης. ὁ. siccatus, antepenac.
ς. τῷ ἀζομένης. ὁ. uerecundus, penacuitur.
ος. ἀθηναίου. ὁ. Athenienſis, penultima
flectitur.
ος. ἀθηναίος. ὁ. Athenæus proprium, an
nacuitur.
ς. ὁ. turbatio, antepenacuitur.
δρός. ὁ. densus, pen acuitur.
τῷ ἀθῴος. ὁ. indemnis, penanflectitur.
τῷ ἀθῷος. ὁ. Iouis epitethon, antepenac.

ograuis, acuitur.
αἰνότοκος. αἰνοτόκου. ὁ. ἡ. mala pariens, antepenacuitur.
αἰνοτόκος. αἰνοτόκος. ὁ. ἡ. male natus, penacuitur.
αἴολος. αἰόλος. ὁ. Aeolus rex uentorum, antepenacuitur.
αἰόλος. αἰόλος. uarius, penacuitur.
αἰπεῖα. αἰπείας. ἡ. alta, circunflexa penult.
αἴπεια. αἰπείας. ἡ. nomen oppidi, antepenultima acuitur.
αἴρων. τὸ αἴροντος. ὁ. tollens, acuitur.
ἀρῶν. τὸ ἀρῶνος. ὁ. accipiens, circunflectitur.
ἀκεσής. ἀκεσοῦ. ὁ. medicus, acuitur.
ἀκέσης. ἀκέσου. ὁ. Acestes & sartor, penacuitur.
ἀκήλητος. ἀκηλήτου. ὁ. ἡ. inexorabilis, antepenac.
ἀκήλητος. ἀκηλήτου. ὁ. immaculatus, acuitur.
ἀκίς. ἀκίδος. ὁ. cuspis, telum, acuitur.
ἄκις. ἀκίδος. ὁ. Acis fluuius, penacuitur.
ἄκρις. ἄκριδος. ἡ. Acris oppidum, penac.
ἀκρὶς. ἀκρίδος. ἡ. locusta, acuitur.
ἄληθα. uerè aduerbium, antepenacuitur.
ἀληθὲς. uerum, acuitur.
ἀμητός. ἀμητοῦ. ὁ. messis tempus, acuitur.
ἄμητος. ἀμήτου. ὁ. messis fruges, antepenac.
ἀμυγδαλῆ. arbor, anflectitur.
ἀμυγδάλη. fructus, penacuitur.
ἄμφις. ἄμφιος. ὁ. Amphis nomen proprium, penacuitur.
ἀμφὶς. aduerbium, sine, acuitur.
ἀνὰ προόδεσις. per, acuitur.
ἄνα. obsecrandi dictio, penacuitur.
ἀναγνὸς. ἀνάγνου. ὁ. impurus, antepenacuitur.
ἀναγνὸς. ὁτου. τὸ. occultum, acuitur.
ἀντίκρυς. contrà, penultima acuta.
ἀντίκρυς. ferè, antepenultima acuta.
ἅπερ. quæ, aspiratur.
ἁπτῶς. tanquam, cum tenui accentu.
ἄπλοος. ἀπλόου. ὁ. innauigabilis, antepenultima acuitur.
ἁπλόος. ὁου. ὁ. simplex, penacuitur.
ἀπόλλυω. ἀπὸ ὀλύω Μ. perdo.
ἀπολύω. ἀπὸ ἐνός λ. dimitto.
ἁπτὸς. ἁπτοῦ. ἀπὸ τοῦ ο μικροῦ. tangibilis, acuitur.
ἀπτὼς. ἀπτῶτος. ἀπὸ τοῦ ω μεγάλου. non cadens, intrepidus, acuitur.
ἄρα, ἐπιφώνημα. fortè, igitur, penanflectitur.
ἀρά. completiua particula, penacuitur.
ἀρὰ. ἡ ἀρᾶς. ἡ. nocumentum.
ἀρᾶος. ἀραίου. ὁ. subditus maledictioni, penanflectitur.
ἀραιὸς. ἀραιοῦ. ὁ. tenuis, rarus, acuitur.
ἄργος. ἄργου. ὁ. onus, penacuitur.
ἄργος. ἄργους. τὸ. Argos ciuitas Pelopon.
ἄργος. ἄργου. ὁ. Argus, penacuitur.
ἀργὸς. ἀργοῦ. ὁ. albus, otiosus, uelox, acuitur.